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Foreword

As GUEST editor of this number of *The American Journal of Clinical Nutrition* I have selected several communications representative of the diversity of nutritional interests in this medical school and of its association with other workers in the field of nutrition. These papers illustrate but a small portion of the subject areas which might have been included. It is hoped that they will provide the reader with an impression of the scope of nutrition interests which can exist within a medical center and, at the same time, indicate the numerous opportunities and responsibilities for education in nutrition afforded by a staff conscious of the subject of nutrition as it relates to different medical specialties.

Some years ago we discussed nutrition in the medical school curriculum[1] and nutrition surveys in relation to professional training in schools of medicine and public health.[2] The present journal illustrates the thesis there expressed, that nutrition permeates all facets of medicine, both clinical and basic medical sciences. (Indeed, no less an authority than Hippocrates stated that " . . . the art of Medicine would not have been invented at first, nor would it have been made a subject of investigation (for there would be no need of it), if when men were indisposed, the same food and other articles of regimen which they eat and drink when in good health were proper for them, and if no others were preferable to these . . . .") It further illustrates the remarkable exchange of ideas among professional workers from many fields when they are jointly engaged in a nutrition survey.

The teaching and learning opportunities afforded by nutrition surveys have been notably recognized and exploited by eleven studies completed to date by the Interdepartmental Committee on Nutrition for National Defense. The results of one such survey in the Republic of the Philippines are included in this collection. The valuable and inevitable interinstitutional and international associations and exchanges which occur through these experiences are illustrated by this report and its accompanying paper by two members of the faculty of the University of the Philippines. This report is in the present number because several members of the staff of Vanderbilt University participated in the survey. Indeed, the pertinence of inclusion of this paper in a Vanderbilt University number is enhanced by the fact that Dr. Manuel Macapinlac has, since engaging in this work, completed a period of graduate study in nutritional biochemistry at this university.

It may be of interest to relate the background of the Division of Nutrition of the Vanderbilt University School of Medicine as an example of a permanent nutrition unit within a medical school. Prior to 1939 several members of different departments of this medical school were engaged in research related to nutrition. During 1939 to 1941 interest in nutrition became somewhat more focused through the conduct of a series of nutrition surveys within the general population. These pioneering surveys were made under the direction of Dr. John B. Youmans and were cooperative undertakings of the Departments of Medicine and of Biochemistry. From 1943 to 1947 these studies* of nutri-

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tion of populations were sponsored cooperatively by the Tennessee Department of Public Health and Vanderbilt University and were initially directed by Dr. William D. Robinson (who is now Professor and Head of the Department of Medicine, University of Michigan, Ann Arbor). Subsequently, they were directed by me. In 1945 five departments (Preventive Medicine and Public Health, Obstetrics and Gynecology, Pediatrics, Medicine and Biochemistry) of this medical school combined resources in an intensive nutrition investigation of women attending the Vanderbilt University Hospital Prenatal Clinic and of infants born to these mothers. This study, known as the Vanderbilt Cooperative Study of Maternal and Infant Nutrition, led to a long and close interdepartmental emphasis on nutrition. In 1947 the desirability of having a continuing unit in the school to represent the sphere of nutrition was recognized through the establishment of the Division of Nutrition. To this division was designated a responsibility for assuring continuous research and teaching stimulus and facilities for the subject area of nutrition.

In the late 1930's a one-quarter course in nutrition had been instituted in the medical curriculum. Initially, this course was offered jointly by the Departments of Biochemistry and of Medicine. At present a course in the Fundamentals of Human Nutrition is the responsibility of the Division of Nutrition and instruction is provided by members of the staff of that division in conjunction with the staff of the Departments of Biochemistry, Medicine, Obstetrics and Gynecology, Pediatrics, and by visiting lecturers. This course is given during the last quarter of the second year of the medical school curriculum. It gives the student an understanding of the physiology and biochemistry of nutrition and relates the subject of nutrition to disease states. Subject matter peculiarly that of medical specialties is not presented in this course but is covered by the appropriate specialties. For example, the subject of infant feeding *per se* is taught by the staff of the Department of Pediatrics and not presented in this course on nutrition. However, in the course on nutrition the medical student is provided with sufficient background to understand and appraise the requirements and adequacy of infant feeding. Likewise he is introduced to the principles of therapeutic dietetics, but therapeutic dietetics as such is a subject which the student encounters later in his experience in the medical, surgical and other clinics and through association with the members of the Department of Dietetics.

The Division of Nutrition maintains an independent investigative program as well as a varying number of cooperative research undertakings with staff members, fellows and students in other departments of the medical school. It does not attempt to encompass all the work in nutrition which is carried out within the medical school. Instead, its function in this regard is to assure a continuing and active interest and program of research in nutrition throughout the institution.

Among the associated groups in the Vanderbilt University Medical Center is the Department of Dietetics. In our cooperation with this department we have become aware that many of the functions, services and resources of departments of dietetics in medical centers are often not recognized or used to their fullest in the varied programs—educational, medical, research and community—of medical centers. Accordingly, I have asked Miss Bernice Hopkins, Director, Department of Dietetics, Vanderbilt University Hospital, to prepare a description of the activities of that department as an example of the role which departments of dietetics play in the modern university medical center. This is published in the accompanying article.

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The Roles of the Department of Dietetics in a University Medical Center

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THE roles of the Department of Dietetics in the University Medical Center can well be illustrated by the following description of the Department of Dietetics of Vanderbilt University Hospital.

A considerable development of dietary services at Vanderbilt University Hospital has occurred during the past decade. This department has long had the support and understanding of the hospital administration, the interest and assistance of the faculty of the School of Medicine, of the visiting staff, house staff and other departments of the hospital. We, in turn, have endeavored as members of the medical team to contribute to good patient care. The patient is the primary reason for existence of a Department of Dietetics; his care in regard to diet is our challenge. In order to fulfill this primary responsibility to patients, we must engage in numerous activities, many of which are not widely recognized. I shall briefly discuss these broad areas: food service to patients and personnel, teaching and research.

FOOD SERVICE

One usually thinks "dietitian—food"; hence, let us examine the food service in our hospital, first for patients, then for personnel. Provision of meals for in-patients is by a decentralized service; that is, all food is prepared in a main kitchen and transferred by trucks (heated for hot food) to fourteen serving kitchens. There the food is chosen and served by selective menu for regular and many modified diets and the dietitian and her co-workers, dietetic intern, food service supervisor and dietary aide, are in close contact with the patient and with other members of the patient-care team. It is the dietitian's responsibility to adapt the diet for the individual patient from the prescription of the physician. In order to do so she must know and understand the patient, his food preferences, food patterns, eating habits and, when there is need for change in food patterns, be available to teach the patient and to help him accept the necessary diet regimen. The decentralized type of facility is well adapted for providing such contact with the patient. The proximity of personnel engaged in the care of the patient creates a situation which encourages the exchange of information about him. A member of the nursing service carries the prepared tray to the patient's bed. In so doing, she may relay valuable comments in regard to the reaction of the patient to his tray. The head nurse is easily available for the dietitian to contact; the dietitian is available for discussions with physician, medical students or nurse. The student nurse receives her experience in applied nutrition in this same atmosphere.

The hospitalized patient has many people concerned with his care, as well as visitors, all of whom look to the Department of Dietetics for some kind of food service. Their requirements may be a cup of coffee or a salad to supplement a lunch brought from home; it may be three meals a day, or one meal a day or an occasional meal. To meet these needs this medical center has had an open pay cafeteria for over ten years, a departure from the days when meals were included as part of the staff compensation. This development illustrates a new responsi-

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bility of hospital dietitians. Ten years ago the majority of dietitians were not oriented to the operation of a commercial establishment. Such a responsibility remains a "side line" of the dietitian whose primary concern is for the patient. Nevertheless, this side line is of some considerable importance. For example, our cafeteria serves breakfast to over 400 persons, lunch to 1,000 and dinner to 300 to 400. Another 700 to 800 customers are catered to at the soda fountain on a busy day.

It is of interest to identify the cafeteria clientele. They consist of persons from all walks of life: the staff of the medical school and hospital—medical, nursing, housekeeping, laboratory, secretarial, dietetic—students, professional visitors from all over the United States and many foreign countries, visitors to patients of all categories (staff patients, private patients, semiprivate), and ambulatory and outpatients. The dietitian must apply knowledge of group feeding to provide sufficiently varied menus to appeal to this diverse clientele. A discussion of food service for personnel would be incomplete without recognizing the special meals and parties served from time to time for special visitors or conferees at our medical center, the coffee and cookies for conferences and symposia, served luncheon for postgraduate study groups, or other meetings where food adds to the occasion.

TEACHING

In recognition of these activities the Department of Dietetics has added to its program for the training of personnel through introducing control methods for food and labor costs and other management skills.

The whole teaching program in the department is coordinated by an educational director. The dietetic internship at Vanderbilt University Hospital is now in its thirtieth year. Dietetic interns with a B.S. degree from an accredited university or college with certain specified academic requirements are admitted. The current class numbers twelve from eleven states. The dietetic internship is a general one and provides rotation through all areas of the hospital where a staff dietitian serves. The intern is given an opportunity to apply to a practical situation the theoretic knowledge which she has obtained in college. In addition, she receives 125 class hours of instruction, seminars, field trips, conferences and learning experiences. The dietetic intern at Vanderbilt is taught in part by physicians from the staff of the medical school who discuss disease conditions and the background of dietary treatment; the dietitians follow with the interpretation of the diet.

Student nurses in the Vanderbilt School of Nursing are taught by our dietitians. Nutrition teaching is on an integrated basis, i.e., the student nurse has class work in nutrition, food preparation and then her experience in the patient-care area. The dietetic intern assists in this program. Included in the teaching program are occasional classes for nursing service technicians and licensed practical nurse students. In addition, we are responsible for the teaching of employees and for a constant on-the-job training program.

RESEARCH

Within the past two and a half years a metabolic research unit has been initiated. Two dietitians devote full time to this area and, of course the dietetic intern works in this area. Constant diets are calculated, prepared and served to assist the physicians in their research. At present this area is being expanded due to the occupancy of a new metabolic ward, and, hence, the department's responsibilities for such work will be enhanced.

Other activities of this University Medical Dietetics Department include the servicing of an Out-Patient Department with a full-time dietitian for the instruction of patients who are referred by the physicians for dietary guidance. Outpatients are encouraged to make return visits to the dietitian in order to to guide the progress of the patient. The dietitian works with physicians in many of the special clinics. No formal plan for instruction of private patients exists here at present, but the dietitians do interview private patients upon the request of the attending physician.

In a medical center such as Vanderbilt physicians may request a quantitative evaluation of a dietary intake through a detailed nutritional history. The dietitian contributes such technical skills relative to diet as needed by the physicians engaged in treatment of patients or in various fields of research.

Since Vanderbilt has long been a center of nutrition interest, we frequently have visitors from other countries for varying periods of time, and the Department of Dietetics affords informal training for these. The training course of the Department has attracted students from abroad; one each from Cuba and the Philippines are currently on the staff.

The staff of the dietary department compiles a diet manual which is available at each patient-care division of the hospital for the use of house staff physicians, medical students and others concerned with care of the patient. The manual is almost constantly under revision in order to keep it abreast of the newer developments.

It is the dietitian's responsibility to provide an adequate diet for patients and personnel, to maintain expenditures within a reasonable range and to supply appropriate records as a basis for bettering service to the medical center.

More dietitians must be trained in management to meet the ever increasing demands on the profession. The managerial responsibilities include the control of expenditures of the dietary department, writing of specifications for food, equipment, proper control of receiving, storing, preparation and distribution of food. Important are skills of personnel management, knowledge of labor costs and control, record keeping and interpretation of costs for administrative purposes.

How does one coordinate these various activities? The diversity of the dietitian's responsibilities in a modern medical center makes organization essential. Allocation of responsibility to each staff dietitian, and the development of personnel to accept these specialized duties is an ever-challenging goal.

Clinical Usefulness of the Oral Ascorbic Acid Tolerance Test in Scurvy

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The ascorbic acid content of blood serum (or plasma) reflects within limits the dietary intake of this nutrient. When, however, the concentration approaches zero the simple demonstration of an absence of vitamin C from the serum does not permit one to predict the tissue stores of the vitamin. The concentration of ascorbic acid in the plasma approaches zero some weeks prior to the appearance of clinically detectable lesions of scurvy.[1] The ascorbic acid content of the white cell-platelet layer is a somewhat more sensitive index of tissue stores, but this tedious and difficult determination is not readily adapted to routine use. There is need for a simple, reliable and informative measure of ascorbic acid nutriture whenever the concentration of the vitamin in the serum has dropped to the vanishing point.

Several years ago the reports of Wolfer et al.,[2] Butler and Cushman[3] and Kajdi[4] attracted the attention of one of us toward the possibility of using a "saturation" or "tolerance" type of test to estimate tissue levels of the vitamin. Usefulness was noted of one such procedure which measures serum ascorbic acid in establishing the diagnosis of scurvy in adults[5] but the evidence for this usefulness in spontaneously developing scurvy has not previously been published. The purpose of this report is to present evidence of value of such a procedure, which is suitable for wide clinical application.

A variety of tests has been proposed for the determination of ascorbic acid nutriture. The earlier ones, such as used by Abbasy et al.[6] and Johnson et al.,[7] were based upon the premise that persons with low tissue reserves of ascorbic acid excrete less of a test dose in the urine than do subjects with adequate stores. Tests based on urinary excretion of vitamin C do not distinguish between varying degrees of deficiency at the lower levels of nutriture and we agree with Sinclair's[8] suggestion that their usefulness is limited by several considerations, including lack of conclusive knowledge of metabolism of the vitamin and the mechanism of its renal excretion.

Lund and co-workers[9] observed that two hours after an oral dose of ascorbic acid normal persons had a much higher serum level than did patients with scurvy. Wolfer et al.[2] confirmed this finding in a study of induced scurvy, but no application of the test in the diagnosis of scurvy was described. Stotz and associates[10] used an oral dose of 6 mg./kg. body weight and measured serum levels at hourly intervals for the next five hours. Subjects with fasting levels between 0 to 0.2 mg. per cent had four types of response that were classified as (1) undersaturated, (2) low normal, (3) high normal and (4) saturated. No patients with scurvy were studied. Rinehart and Greenberg[11] used an oral dose of 15 mg./kg. body weight and measured fasting, three-hour and five-hour serum levels. They similarly classified the resulting curves as (1) flat (peak below 0.5 mg. per cent), (2) medium (peak 0.5 to 0.9 mg. per cent) and (3) high (peak above 0.9

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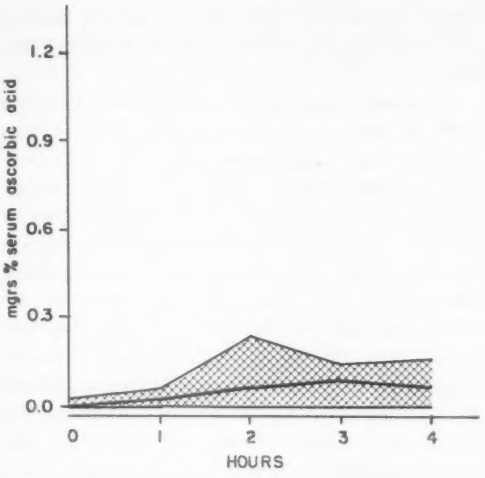

FIG. 1. Mean and range of serum ascorbic acid in nine patients with scurvy after a load test.

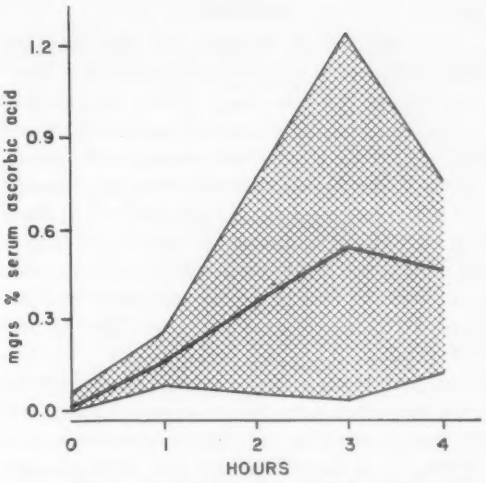

FIG. 2. Mean and range of serum ascorbic acid in eleven patients without scurvy after a load test.

mg. per cent). Again, no patients with clinical scurvy were studied.

Other investigators[12–14] have used similar tests but with intravenous administration of the vitamin. This route may result in a sudden flooding of the kidney with ascorbic acid and a greater opportunity for enhanced urinary loss.

For rapid assessment of the ascorbic acid stores of an individual the type of test used by Wolfer and associates,[2] Stotz et al.[10] and Rinehart and Greenberg[11] has proved to be of value in this laboratory.

CLINICAL MATERIAL AND RESULTS

We are presenting results obtained in twenty-four adult patients. All had a fasting serum ascorbic level of less than 0.1 mg./100 ml. Of these patients, nine had clinical scurvy, three had a history of inadequate intake of ascorbic acid but they did not have clinical scurvy, one had sprue and the remaining eleven patients were hospitalized for reasons unrelated to nutritional disease. They are included because of low fasting serum ascorbic acid levels.

After a fasting blood sample was obtained, an oral dose of ascorbic acid (15 mg./kg. body weight) was given. Successive determinations of serum ascorbic acid levels were made at one, two, three, four and, occasionally, five hours after ingestion. Serum ascorbic acid was measured using a modification of the 2,6-dichlorophenolindophenol method of Mindlin and Butler.[15] In some of the patients with clinical scurvy, successive load tests were performed after periods of therapy.

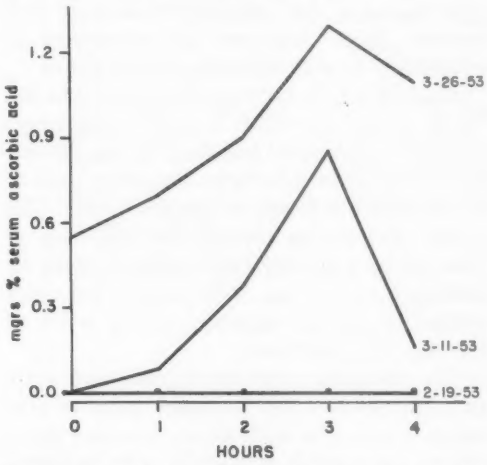

FIG. 3. Successive responses to a load test in a patient with scurvy.

The values obtained on the nine adults with clinical scurvy are plotted in Figure 1. Similar data obtained on the eleven patients without scurvy who had low serum ascorbic acid levels are plotted in Figure 2. Finally, the results of three successive load tests on a patient with scurvy are expressed in Figure 3.

COMMENTS

Examination of Figure 1 reveals that the patients with clinical scurvy exhibited a "flat" response to the test dose. In no instance did the maximum rise in ascorbic acid level exceed 0.25 mg./100 ml. It was considerably less in most of the cases and averaged approximately 0.1 mg. The mean maximum obtained at three hours. This response was similar to that found by Lund et al.[9] who reported that the ascorbic acid levels in four patients with scurvy did not exceed 0.25 mg./100 ml. two hours after an oral test dose of 10 mg./kg. body weight. In children with scurvy Kajdi et al.[4] demonstrated that the serum level did not exceed 0.2 mg./100 ml. four hours after an intramuscular injection of 200 mg. of ascorbic acid. The three patients with a history of grossly inadequate ascorbic acid intake who did not have clinical scurvy gave the same "flat" response as did those with scurvy. These responses are interpreted as evidence of greatly diminished tissue stores.

Figure 2 depicts the range of results obtained in the group of patients having fasting serum levels of ascorbic acid less than 0.1 mg./100 ml. but whose dietary histories did not appear to be markedly deficient in ascorbic acid. This group exhibited an average rise of 0.5 mg. at three hours with only three failing to have an increase above 0.2 mg. The range of responses within this group suggests varying levels of ascorbic acid nutriture.

The changing response to the load tests (Fig. 3) reflects the increased ascorbic acid stores of a patient with scurvy who was given 300 mg. of ascorbic acid orally daily following the initial load test. After twenty-two days the fasting serum ascorbic acid level was still zero, but the maximum increase in serum level at three hours was 0.8 mg. The patient had received approximately 7 gm. of ascorbic acid during this intervening period. The second load test reflects the relatively good stores which had accumulated in the tissues despite the fasting zero concentration in the serum. The response pattern fifteen days later, and after the fasting serum level had risen, showed a higher maximum. Other patients with scurvy treated with larger amounts of ascorbic acid (600 to 1,000 mg. daily) showed fasting levels above 0.2 to 0.3 mg./100 ml. and a normal response pattern to the load test within ten days.

A patient with sprue had a fasting serum level of zero. A level of 0.3 mg./100 ml. was attained only nine hours after the load test. This patient's history indicated a poor dietary intake but he did not show clinical signs of scurvy. The absorptive defects in this disease involve both fat-soluble and water-soluble nutrients.[16] The flat tolerance curve of ascorbic acid and the delayed maximum are consistent with the impaired absorption of water-soluble nutrients as well as a degree of "tissue depletion." Other disorders of absorption might give similar misleading results in the clinical application of this test, and, hence, these should be considered in the interpretation of results in order to avoid erroneous conclusions. Whenever defects of intestinal absorption exist, a parenteral load test should be employed.

SUMMARY AND CONCLUSIONS

The tolerance test (in which 15 mg. of vitamin C/kg. of body weight is administered orally and the ascorbic acid concentration in the serum determined three hours later) is useful in assessing vitamin C nutriture. In patients with scurvy the serum concentration will not increase above 0.25 mg./100 ml. and is usually much less. A maximum rise of ascorbic acid concentration in excess of 0.25 mg./100 ml. is not consistent with the diagnosis of scurvy. In states of severe depletion of tissue stores, or in marked degrees of malabsorption, extremely low values may be encountered in the absence of scurvy. Hence, this test may be of conclusive value in excluding scurvy as a diagnosis and of considerable usefulness in sustaining the diagnosis of scurvy. In its simplest form an initial and a three-hour estimate of serum ascorbic acid will suffice. This is more convenient and widely applicable than measurement of white cell ascorbic acid content or other procedures. The normal rise in serum concentration following the oral dose indicates the presence of appreciable tissue stores even though the fasting serum level of vitamin C may be zero. Informative supplementary information might be obtained in nutrition sur-

veys among populations with less than 0.1 mg. of ascorbic acid /100 ml. serum by first dosing with 15 mg. of ascorbic acid per kg. body weight and then taking the blood sample for estimation of the vitamin three hours later.

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Nutritional Assessment of Infants with Hypochromic Anemia

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IRON deficiency in infancy is almost always due to nutritional factors rather than to loss of blood. The occurrence of iron deficiency in infants between six months and five years of age can be attributed to either an increased requirement or an inadequate intake. In a previous publication[1] it was pointed out that iron deficiency developed more frequently in infants of low birth weight, twins, males and infants born to multiparous mothers, than would have been expected. These findings were interpreted as evidence that their relatively greater growth rate and/or reduced iron "stores" at birth predisposes them to the development of iron deficiency.

The present study is concerned with a dietary and biochemical assessment of the nutritional status of a similar group of infants in order to evaluate the role of iron intake in the pathogenesis of their deficiency.

MATERIALS AND METHODS

Twenty-seven infants with hypochromic anemia with a hemoglobin concentration of less than 9.0 gm. per 100 ml. were studied during a six-month period in the pediatric out-patient clinic. There were eighteen males and nine females; fifteen were Negro and twelve were white. They ranged in age from seven to thirty-six months, with a median of thirteen and a half months. The weight range was 7.5 to 14 kg. with a median of 9.7 kg. The distribution by birth weight and order was comparable to the series previously reported.

Dietary histories were taken by one of us (M.D.G.) who has had previous experience with infant feeding customs of this community. Typical daily food intakes based on the previous twenty-four hours and the frequency of food consumption during the preceding week were recorded. The nutrient intakes were calculated using published tables of food composition.[2,3]

Biochemical nutritional assessments consisted of determination of serum iron,[4] iron binding capacity,[5] calculation of iron saturation (serum iron/serum iron plus iron binding capacity), serum vitamin A,[6] serum ascorbic acid,[7] serum total tocopherols,[8] total serum proteins by a biuret method, and serum albumin following precipitation with 27.8 per cent sodium sulfite.

RESULTS

The dietary histories revealed a pattern of high milk intakes which averaged 42.5 ounces (1,255 ml.) per day. Fifteen infants had daily intakes of more than 1 quart and six drank 2 quarts a day or more. With few exceptions these infants drank fresh whole homogenized milk. Only three infants took nothing but milk. The most commonly used solid foods were crackers, bread, vegetables, fruits and potatoes.

In Table I, the foods consumed and the average daily intakes are recorded. Almost all the infants consumed a variety of solid foods, except three who ate none. Greatly differing feeding patterns were not observed.

The calculated intakes are presented in Table II. The medians and 25th and 75th

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TABLE I

The Pattern of Food Intake of Twenty-Seven Infants with Hypochromic Anemia

Food	No. of Infants	Average Daily Serving
Milk	27	1.4 qt.
Meat and eggs	21	1.0 oz.
Citrus fruits	16	6.0 oz.
Other fruits and vegetables	22	5.0 oz.
Potatoes and legumes	17	4.5 oz.
Cereals, plain	18	3.0 oz.
Cereals, iron fortified	7	1.5 oz.
Bread and crackers	23	1.7 slices or 7 crackers
Sweets (hard candy)	24	1.3 oz.

TABLE II

Calculated Nutrient Intakes of Twenty-Seven Infants with Hypochromic Anemia

Nutrient	Percentiles		
	25th	50th	75th
Calories (/kg.)	113	135	163
Protein (gm./kg.)	4.3	5.3	7.0
Calcium (mg.)	1,240	1,370	1,850
Phosphorus (mg.)	1,100	1,325	1,750
Vitamin A (I.U.)	2,400	3,200	4,300
Vitamin C (mg.)	18	26	57
Tocopherols (mg.)	4.0	8.0	11.0
Thiamine (mg.)	0.45	0.63	0.78
Riboflavin (mg.)	1.75	2.22	3.32
Niacin (mg.)	2.23	3.42	5.45
Fat (per cent of calories)	38.2	43.7	46.7
Iron (mg.)	2.4	4.4	6.1

percentiles are given to characterize the group. Occasional extremely low or high values occurred. Iron intakes are shown in Figure 1. The results of the biochemical assessments are presented in Table III.

TABLE III

Biochemical Findings in Twenty-Seven Infants with Hypochromic Anemia

Nutrient	No. of Infants	Mean ± Standard Error of Mean
Serum iron (μg./100 ml.)	27	58.4 ± 5.3
Iron saturation (%)	25	10.9 ± 0.87
Vitamin A (I.U./100 ml.)	19	117.6 ± 10.7
Ascorbic acid (mg./100 ml.)	20	0.73 ± 0.09
Total tocopherols (mg./100 ml.)	19	0.91 ± 0.10
Total serum proteins (gm./100 ml.)	26	6.16 ± 0.12
Serum albumin (gm./100 ml.)	26	4.15 ± 0.08

COMMENTS

The nutritional adequacy of the diets consumed by these iron-deficient infants can be evaluated by comparing their intakes with those of healthy infants. The recent data of Beal[9] from the Child Research Council, Denver, provide a suitable standard for comparison. The caloric intake of the anemic infants is much higher than that of the infants in Denver who had a median intake of 92 to 106 calories per kg. between six months and three years of age. It is possible that a single dietary history would give intakes which are greater than those actually consumed. However, milk supplied approximately 65 per cent of the calories, and the histories of milk intake appeared to be commensurate with our experience with many other infants from the same socioeconomic group. Milk intake is relatively easy to quantitate and we believe

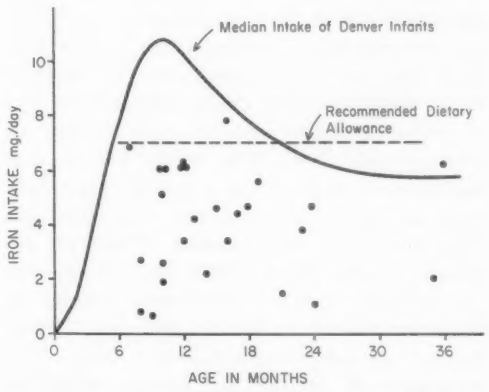

FIG. 1. Iron intake of twenty-seven iron-deficient infants plotted according to age and compared with the median intake of healthy infants[10] and the Recommended Dietary Allowance for this age group.[11]

these data to be valid. Most of these infants took their milk from a bottle, which was their constant companion by day, and was offered to them whenever they awoke at night.*

The intake of protein, calcium, phosphorus, riboflavin and vitamin A is likewise higher by 25 per cent than those of the infants in Denver, as all these nutrients are largely derived from milk.

By contrast, iron intake in these infants was lower than that in the healthy infants. The median iron intakes reported by Beal[10] are shown in Figure 1. Iron-fortified cereals furnished half of the iron intake at one year of age but were not consumed after the age of two years. The high iron intake in the infants between six and eighteen months of age in Beal's study is entirely due to the consumption of large amounts of infant cereal. The Recommended Dietary Allowance[11] for infants in this age group is 7 mg. per day. The iron intake of the present group, including the small amount consumed as iron fortified infant cereals and enriched flour, was approximately half of that reported by Beal. Only ten of the twenty-seven infants had an intake exceeding 5 mg. per day.

In seventeen infants, the intake of iron appeared grossly inadequate and can be considered to be of etiologic significance in the development of iron deficiency. In the other ten infants with an iron intake of more than 5 mg. per day, other etiologic influences probably should be considered as well. It was not possible to separate these ten infants from the rest of the group on the basis of birth weight or birth order, although one set of twins studied had an iron intake of 6.1 mg. per day. The utilization of oral radioactive iron for hemoglobin formation was also studied in this group of infants[12] and iron absorption was normal. They all responded normally to treatment with iron (as ferrous sulfate) administered orally in doses equivalent to 45 mg. per day. There was no apparent excessive loss of iron. The regularity of the dietary intake might be questioned, but this could not be definitely incriminated. It can only be concluded that the need for iron in these infants was greater than the amount provided by their intake.

The intake of thiamine in these infants is less than that of the Denver infants in many instances, but it is not so low as that associated with deficiency states. The intake of niacin has been recorded without consideration of the tryptophan content of a milk diet which, at these high protein intakes, is ample to meet the requirements for niacin. The vitamin A intake is ample and the serum concentrations are all within the normal range.

Although the dietary ascorbic acid is less than the Recommended Dietary Allowances or than the intake of the Denver infants, no serum concentrations of less than 0.15 mg. per 100 ml. were found and the average was in the acceptable range. The total tocopherol concentration in the serum was equivalent to adult normal values and only one infant had less than 0.50 mg. per 100 ml., the level associated with increased peroxide hemolysis. The serum protein concentrations are within normal limits for this age group as would be expected from the protein intake. In ninety similar infants, an albumin concentration of less than 3 gm. per 100 ml. was found in a single instance.

SUMMARY

Dietary histories on twenty-seven infants with hypochromic anemia show excessive milk consumption with high caloric intake. Their diets appeared to be adequate in all nutrients but iron. Seventeen of twenty-seven infants had a daily dietary intake of less than 5 mg. iron.

The presence of iron deficiency in ten infants having an iron intake of 5 to 7 mg. per day indicates that such an intake may be inadequate for infants predisposed to iron deficiency by rapid growth or depleted iron stores.

These studies emphasize the importance of iron-rich cereals and other foods in the diet of the infants for the prevention of dietary deficiency. There was no evidence of other dietary deficiencies among these anemic iron-deficient children.

* Such infants are called "milkoholics" by the pediatric house staff.

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Iron Deficiency in Gynecologic Patients

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IRON deficiency anemia among adults in the United States occurs almost exclusively as a result of chronic blood loss. In the absence of blood loss, inadequate iron intake can lead to anemia only after prolonged deprivation. Dietary restriction of iron may become limiting under circumstances in which requirements are increased, as during pregnancy, lactation, the rapid growth of infancy and childhood, or with chronic mild hemorrhage such as excessive menstruation. The present study illustrates the nature of this blood loss effect on the therapeutic response to iron and to iron plus other hemopoietic preparations in the management of metorrhagically induced iron deficiency anemia. From these data, we have attempted to estimate the quantity of iron lost by the woman with repetitively excessive menstrual blood loss which has led to anemia, the amount of iron required to replace this deficit, and finally, whether factors other than iron reinforce or enhance the hemopoietic response in such a person.

MATERIAL AND METHODS

Only women in their reproductive period of life were entered in the study. Their composition by race, age and weight is presented in Table I. All patients had confirmed evidence of iron deficiency anemia. The criteria included: a mean cell volume (MCV) of less than 75 cu.μ. and/or a mean cell hemoglobin concentration (MCHC) of less than 30 per cent. Nineteen of the patients revealed evidence of iron deficiency by both criteria. In twenty-five women only hypochromia was present. In the remaining six persons microcytosis was the predominant feature.

In all instances the cause of excessive blood loss was menstrual disorders associated with benign pelvic conditions, i.e., functional uterine bleeding due to endocrine failure or uterine tumors such as fibroids and polyps. Women who were pregnant, had aborted, or were lactating, or who had gynecologic malignancies were not included in the present study. Of the group, ten patients came to final operative treatment during the observation period for the management of their gynecologic disorders. Such treatment consisted of dilatation of the cervix and curettement of the uterine endometrium or total abdominal hysterectomy.

Patients accepted for the study had three baseline evaluations on three successive days prior to initiation of therapy. The red blood count (R.B.C.), hemoglobin (Hb) and packed cell volume (PCV) were measured on venous blood treated with mixed potassium and ammonium oxalate, and the procedures were carried out within twenty minutes of obtaining the sample. Wintrobe's blood indices were calculated. Reticulocyte counts were made on capillary blood using wet preparations. Hemoglobin was determined photoelectrically by the cyanmethemoglobin method.[1] The packed cell volume[2] was measured in Wintrobe hematocrit tubes after being centrifuged at 3,000 r.p.m. for thirty minutes. Erythrocytes[3] were counted in duplicate after mixing with Hayem's solution.

Following the initial determinations each patient was assigned alternately to one of the therapy groups on the basis of her initial hemoglobin level (Table II). The duration of hematologic observations during therapy averaged eleven weeks and ranged to twenty-four weeks, while post-therapy follow-up has extended an additional one to two years. Fifty persons

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received encapsulated ferrous sulfate orally in dosage levels equivalent to 60, 100 or 300 mg. per day of elemental ferrous iron. There were seventeen additional women similarly studied, six of whom received an oral liver concentrate elixir containing the equivalent of 60 mg. of elemental iron and eleven who received the liver concentrate plus added ferrous sulfate to bring their total iron intake to 100 mg. of ferrous iron per day. During therapy blood values including reticulocyte counts were determined daily for the first two weeks. Subsequently biweekly (for six weeks) and weekly (for three months) observations were made. Each patient returned immediately following the completion of her menses for hematologic assessment.

This report presents primarily the results of the iron therapy groups. As the liver concentrate contained some iron (60 mg. elemental iron per day) and other possible hemopoietic substances, there was the opportunity to compare the efficacy of iron therapy with a "shotgun type" of hematinic. By analysis this liver concentrate supplied daily:

Iron....60 mg.	Pyridoxine hydrochloride....1 mg.
Copper....1.8 mg.	Pantothenic acid.8.7 mg.
Riboflavin.2.8 mg.	Vitamin B_{12}....20 μg.
Niacin...27 mg.	Inositol.....30 mg.
Thiamin...2 mg.	Choline.....60 mg.

All the essential members of the vitamin B complex are present in amounts at least equal to the National Research Council's Recommended Allowances.[4] All iron, liver and liver plus iron therapy was administered orally in three divided daily doses.

TABLE I

Iron Deficiency in Gynecologic Patients, and Treatment

Dosage of iron (mg.) per day	60	100	300	
Number of cases	19	14	17	50
Negro	12	5	9	26
White	7	9	8	24
Age (yr.)				
Mean	37	34	37	36
Range	22–50	20–45	22–44	20–50
Weight (kg.):				
Mean	71	69	66	69
Range	50–96	50–105	50–96	50–105
Calculated blood volume (L.):				
Mean	4.6	4.6	4.2	4.6
Range	3.3–6.3	3.3–6.9	3.3–6.3	3.3–6.9

NOTE: Figures in last column represent totals.

TABLE II

Distribution of Initial Hemoglobin Concentrations

Dosage of iron (mg.) per day	60	100	300	
Number of cases	19	14	17	50
Hemoglobin (gm./100 ml.):				
<6.0	2	2	2	6
6.0–6.9	2	1	1	4
7.0–7.9	3	4	1	8
8.0–8.9	2	2	6	10
9.0–9.9	4	3	6	13
>10.0	6	2	1	9

NOTE: Figures in last column represent totals.

RESULTS

Classification of the patients by therapeutic dosage level of iron and initial hemoglobin value is presented in Table II. It may be noted that all fifty patients had hemoglobin values of 10 gm. or less per 100 ml., and evidence of hypochromia and/or microcytosis. The erythrocyte count was more than 4 million in twenty-four patients, between 3.9 and 3.5 million in twelve, and less than 3.5 million in the remaining fourteen. While blood volume determinations were not made in this group, evidence from the literature[5] indicates that chronic blood loss of the nature here studied is not associated with appreciable changes in the total blood volume. Calculated blood volumes based on 66 cc. per kg. of body weight[6,7] are shown for these somewhat obese women in Table I.

Eleven patients did not experience additional menstrual loss during their period of therapy and observation. In the remaining thirty-nine patients it is possible to calculate a minimal iron loss during menses per period during therapy. This calculation is based on the observed changes in hemoglobin concentration as a result of menstruation and the estimated blood volume. The accepted normal menstrual blood

TABLE III

Calculated* Minimal Iron Loss per Menstrual Period During Therapy

Dosage of iron (mg.) per day	60	100	300	
Number of cases	19	14	17	50
Iron loss (mg.) per period:				
Nil†	3	3	5	11
<39 (14)	2	2	3	7
40–79	2	1	3	6
80–119	5	3	1	9
120–159	1	1	1	3
160–199	1	2	3	6
200–239	1	0	1	2
>240 (313)	4	2	0	6

NOTE: Figures in last column represent totals.

* Calculated from decrease in hemoglobin concentration during menses and estimate of blood volume.

† Amenorrheic or postoperative.

loss is from 35 to 70 ml. per period. This is equivalent to 14 to 28 mg. of elemental iron per period. It is evident (Table III) that in the study group the amount of blood and resultant iron loss was considerably in excess of 28 mg. of iron per period. Only one patient had losses in the accepted range of normal (14 mg.) while the greatest blood loss amounted to over 300 mg. of iron per period. This latter would be equivalent to 750 ml. of whole blood being lost per menses. These estimates refer to decreases in total body iron. Expressed as quantities of iron in the diet necessary to meet the losses, taking into account absorption and utilization, they would represent the metabolism of up to 10 mg. of elemental iron per day, or a tenfold increase over normal uptake of iron from dietary sources.[8]

The average hemoglobin responses of the persons receiving one of the five therapeutic agents are shown in Figures 1 through 6. Each chart represents the results of therapy during the initial ten weeks of observation among persons with similar initial levels of hemoglobin deficit.

As expected, the level of reticulocytosis was correlated to the initial hemoglobin value. The minimal response observed was 1.7 per cent and the maximum 18.6 per cent. There was no appreciable difference in the degree of response by the various levels of therapeutic iron. The average reticulocyte peak was 5.0 per cent for the 60 mg. of iron, 6.4 per cent for the 100 mg. level, and 5.7 per cent for those receiving 300 mg. of iron. The day of peak response was somewhat earlier in the group taking the lowest iron dosage than in the other two (mean time, 60 mg. at the sixth day, 100 and 300 mg. group on the tenth day of therapy). This difference is probably not physiologically meaningful.

Of equal interest is the length of time required for relapse once therapy was discontinued. Among the thirty-nine patients who continued to have excessive menstrual blood loss with each period there was no difference in relapse time whether they had received 60 mg. of elemental iron (34 to 590 plus days), 100 mg.

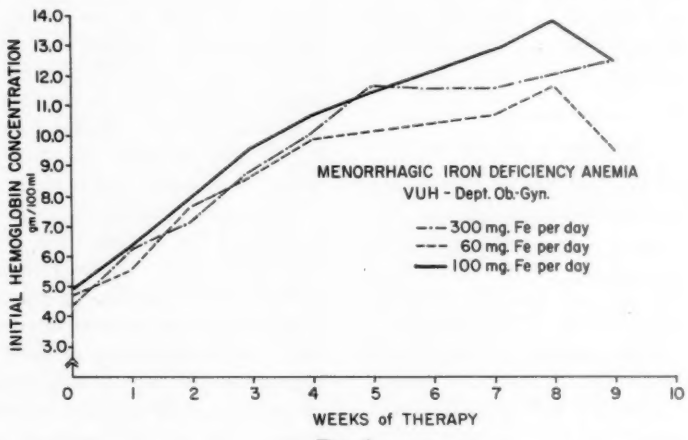
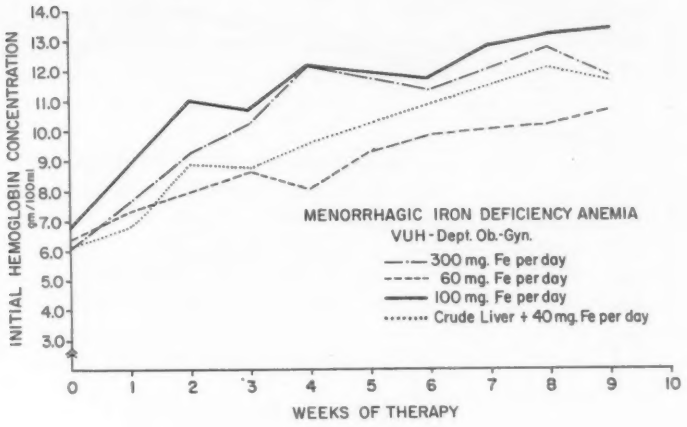


FIG. 1



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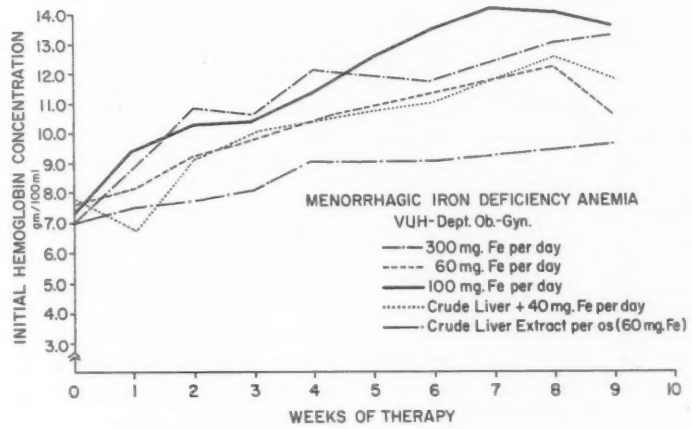


FIG. 3

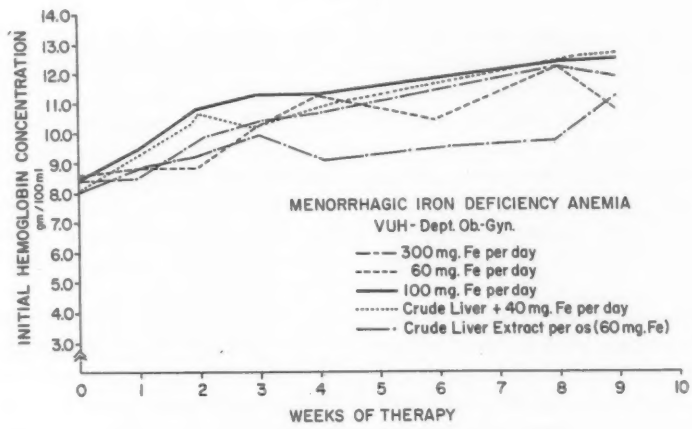
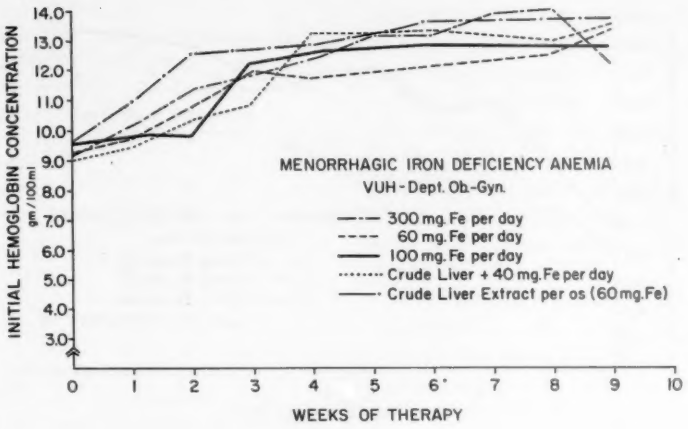


FIG. 4



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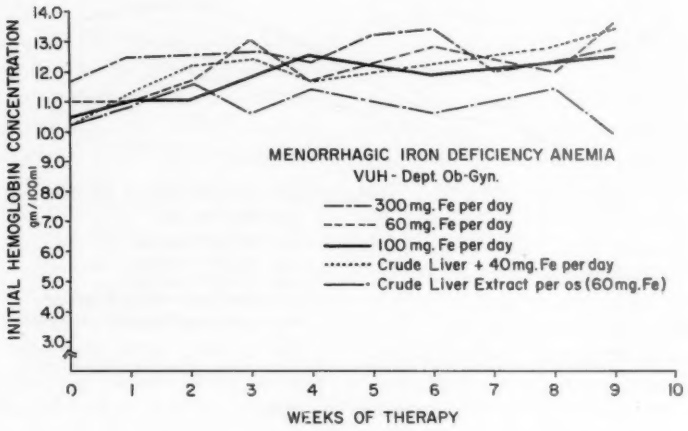

FIG. 6

(31 to 620 plus days) or 300 mg. (22 to 470 plus days). Obviously the time of relapse was dependent on the patient continuing to lose blood through menstruation and the amount of blood loss associated with these menses. As there were no appreciable differences among the groups in their calculated iron loss from menses (Table III) iron dosage level did not influence the time required for hematologic relapse.

The initial therapeutic responses show that regardless of iron dosage level the hemoglobin concentration can be raised from as low as 4 gm. per 100 ml. to values in excess of 10 gm. per 100 ml. within four weeks (twenty-eight days) after the initiation of iron therapy. These data (Figures 1 to 6) indicate that: (1) The maximum effectiveness is achieved with therapeutic iron at the level of 100 to 300 mg. per day. (2) No superiority in initial response or relapse time can be demonstrated for the 300 mg. per day iron dosage. (3) No difference in therapeutic efficacy exists between 100 mg. of iron alone and the liver concentrate (containing 60 mg. of iron per day plus a variety of other nutrients and an added 40 mg. of iron). (4) Persons taking 60 mg. of iron had slower rates of hemoglobin regeneration than did those receiving 100 mg. or more, and it would appear that this dosage level (60 mg.) is not adequate for maximal regeneration in the presence of repetitive menstrual loss. (5) Patients re-

ceiving liver alone (containing 60 mg. of elemental iron per day) showed no superiority to those taking similar levels of iron alone. Actually they exhibited the lowest degree of hematologic response.

In the correction of the blood indices (MCV and MCHC) in response to iron therapy it is noteworthy that the microcytosis was invariably corrected first and that the hypochromia changed more slowly. Hypochromia in subsequent relapse presented as the first evidence of recurring iron deficiency. Hypochromia is a more sensitive index of iron deficiency anemia than is microcytosis.

In a further attempt to appraise the relative merits of the three dosage levels of iron, the average increase of hemoglobin concentration per week after the initiation of therapy but prior to the onset of additional menstrual blood loss has been calculated and is presented in Table IV. The groupings are based, as previously, by initial hemoglobin level and level of therapeutic iron. The inferior performance of 60 mg. of iron is further evident in these data. The over-all average rate of hemoglobin regeneration to the three dosage levels was 1.1 gm. per 100 ml. per week. The rate of response among women with less than 6.0 gm. of hemoglobin compares favorably with maximal rates (1.82 gm. per 100 ml. per week) of regeneration reported for parenterally administered massive doses of iron.[9] It is apparent that the rate of regeneration per week decreased as the initial hemoglobin concentration approached more normal values.

TABLE IV

Average Increase in Hemoglobin Concentration per Week During Treatment and Prior to Onset of Menstrual Loss

Dosage of iron (mg.) per day	60	100	300	
Number of cases	19	14	17	
Initial hemoglobin concentration (gm./100 ml.):	Mean Hemoglobin Gain (gm./wk.)			
<6.0	1.8	1.9	1.7	1.8
6.0–6.9	0.9	1.6	1.7	1.3
7.0–7.9	0.6	1.3	2.2	1.2
8.0–8.9	0.9	1.3	1.0	1.0
9.0–9.9	0.9	1.0	1.0	1.0
>10.0	0.6	0.7	0.8	0.7
Average hemoglobin gain (gm./wk.)	0.9	1.2	1.2	1.1

NOTE: Figures in last column represent averages.

In thirty-nine of the patients there was repetitive menstrual blood loss during the therapeutic trial. It can be seen in Table V that the net hemoglobin gain (in gm. per 100 ml.) per week of therapy averaged 0.6 gm. per 100 ml. When the rate of regeneration was determined by initial hemoglobin and by calculated menstrual iron loss, numbers of patients in

TABLE V

Net Gain* in Hemoglobin Concentration per Week of Therapy

Blood loss (as mg. of iron)	Nil	<39	40–79	80–119	120–159	160–199	≥200	
Initial hemoglobin level (gm./100 ml.):	Net Hemoglobin Gain (gm./wk.)							
<6.0	1.7	..	..	0.7	0.5	1.0	0.9	1.2
6.0–6.9	..	0.4	0.9	0.7	..	..	0.7	0.7
7.0–7.9	1.4	0.5	..	0.6	..	0.8	0.8	0.7
8.0–8.9	0.6	0.4	0.4	0.5	0.6	..	0.7	0.5
9.0–9.9	0.4	0.3	0.5	0.6	..	0.7	0.6	0.4
>10.0	0.3	..	0.5	..	0.2	..	..	0.3
Average net hemoglobin gain (gm./wk.)	0.9	0.4	0.6	0.6	0.4	0.8	0.7	0.6

NOTE: Figures in last column represent averages.

* Gain in blood hemoglobin concentration adjusted for observed menstrual loss.

each subgroup were small. As a result, we were unable to detect any differences at the 60, 100 or 300 mg. dosage level of iron. Thus, we have combined the groups in this table. There appears to be positive correlation between the amount of hemoglobin regeneration and (1) the extent of iron loss per menses, and (2) the initial level of hemoglobin concentration. However, the effect of menses has reduced the hemoglobin regeneration by from 0.3 to 0.6 gm. per 100 ml. per week as compared to the response prior to the onset of menstruation (Table IV) during which therapeutic period no blood loss occurred.

COMMENTS

Well documented evidence[8] reveals that the average American woman has a dietary iron intake of 12 to 15 mg. per day. Of this amount, some 10 per cent (1.2 to 1.5 mg. per day) can be absorbed and utilized. Daily losses, exclusive of menses, pregnancy or lactation, amount to 1 mg. or less. Hence, she is easily able to maintain iron balance.

During pregnancy fetal and maternal demands for iron are increased, but so is the mother's ability to absorb this nutrient. Evidence indicates[10] that during the third trimester of pregnancy from 3.6 to 4.5 mg. of iron per day may be absorbed from a dietary intake of 12 to 15 mg. As a result, in the absence of complicating blood loss during pregnancy, delivery or postpartum, iron deficiency anemia does not develop in a normal pregnant woman. The usually accepted amount of menstrual blood loss is from 35 to 70 ml. per period, which is equivalent to 14 to 28 mg. of iron per menses. To meet this normal loss the woman needs an additional 0.5 to 1.0 mg. of iron per day to maintain a constant level of hemoglobin. From such reasoning one might conclude that only the woman having minimal menstrual bleeding could maintain her hemoglobin concentration. However, in most women during their normal menstrual lives progressively lower and lower hemoglobin values do not develop. Menstruating women do have lower levels than comparably aged men (by 2.0 to 2.5 mg. per 100 ml.) and prior to menarche and postmenopausally this sex differential tends to disappear. This hemoglobin concentration differential between the sexes is not dependent on dietary iron intake. Indeed, even in populations where iron intakes of 100 to 500 mg. per day occur, the differential persists.[11]

When there is repetitive excessive blood loss at the time of menses, iron deficiency anemia can and does occur. For practical purposes any non-pregnant, non-lactating woman with hypochromic microcytic anemia should be considered as an excessive bleeder until positively proved otherwise. Among women the obvious source of such an excess is meno- or metrorrhagia.

Early recognition by the physician of the amount of blood (hence iron) that a woman can lose through repetitive episodes of excessive menstrual flow is the best preventitive of iron deficiency anemia in women during their reproductive life. When the physician employs the usual means of evaluating a woman's menstrual history the actual amount of blood loss may be underestimated. If one utilizes the traditional classification of menstrual flow (slight, moderate or heavy) this will permit losses to be judged as within normal variation when the blood losses, as measured, are up to twice the 70 ml. of blood per period which is the accepted upper limit. So beware the menstruating woman with iron deficiency anemia!

As has been demonstrated previously,[12] the present study reconfirms that the response to hemopoietic therapy of a person with iron deficiency anemia is solely the result of administered iron. The addition of trace minerals and other hemopoietic agents in "shotgun" mixtures does not enhance the patient's hematologic recovery. The liver concentrate employed in this study contained a combination of several such other hemopoietics but had no demonstrable superiority. The level of iron therapy (100 mg. of elemental iron per day given in three divided doses) which produced maximal hemoglobin regeneration and hematologic remission time is but one-third the usually prescribed oral medication of 300 mg. of elemental iron (1.0 gm. of ferrous sulfate) per day. An incidental clinical observation related to this was the almost complete absence of annoying side effects to the 100 mg. dosage in

contrast to the recognized inability of some patients to tolerate the 300 mg. level.

CONCLUSIONS AND SUMMARY

Women with iron deficiency anemia as a result of chronic menstrual blood loss have been studied. The therapeutic effectiveness of three intake levels of oral iron as ferrous sulfate and in combination with a broad-spectrum hemopoietic liver concentrate has been studied by comparison of initial response and remission duration. The intake of 100 mg. per day of ferrous iron (as $FeSO_4$) suffices to produce maximal response.

The calculated amount of iron (in blood) lost at the time of menses was up to ten times the upper limit of the accepted norm.

From the present therapeutic trial, when iron was given as ferrous sulfate or iron in liver concentrate, it is apparent that (1) 60 mg. of iron per day does not provide for maximal hematologic response; (2) no detectable superiority was evident for the 300 mg. iron dose over the 100 mg. intake; (3) the addition of hemopoietic substances did not enhance the patient's response compared to iron therapy alone; (4) four weeks of 100 mg. per day of iron will raise the hemoglobin concentration above 10 gm. per 100 ml. when the initial value is as low as 5 gm. per cent.

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Intestinal Absorption of C^{14}-Palmitic Acid and C^{14}-Tripalmitin in the Rat

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DIGESTION of fats results in a mixture of fatty acids, mono-, di- and triglycerides, in the intestinal contents. However, the predominant lipid in intestinal or thoracic duct lymph is triglyceride although small amounts of free fatty acids and of phospholipids are also present. Numerous studies have been concerned with the contents of the small intestine during digestion and with the lipids found in the intestinal or thoracic duct lymph during absorption. Study of the composition of lipids in intestinal tissue during digestion and absorption has been confined largely to phospholipids and total glycerides (as the neutral fat fraction) without regard to the fractionation of the glycerides. Recently, Johnston[1] observed that *in vitro* preparations of intestine transferred C^{14}-palmitic acid from the mucosal to the serosal side. Although most of the activity found in the neutral fat fraction resided in triglycerides, a significant amount of activity was also present in the diglycerides. Skipski, Morehouse and Deuel[2] studied the absorption of a 1,3-dioleyl-2-deuteriostearyl glyceride-C^{14} and a 1-monodeuteriostearyl glyceride-C^{14} in the rat and identified in the intestinal neutral fat component a monoglyceride with an isotopic ratio very nearly equal to that of the glycerides fed.

In an effort to relate the activity of the lipids of the intestine to the composition of the lipid being absorbed we have investigated the distribution of C^{14} in the lipid fractions of the intestine and of intestinal contents at various intervals after feeding C^{14}-palmitic acid or C^{14}-tripalmitin. In some of the experiments the lipids of the liver also were fractionated and the distribution of C^{14}-fatty acids in lipid fractions was determined.

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MATERIALS AND METHODS

A dose of 100 mg. of carboxyl-labeled palmitic acid or tripalmitin in 1 ml. of olive oil was administered by stomach tube to fed adult male Sprague-Dawley rats. The animals were killed by decapitation three, six or twenty-four hours later. At least two and in some cases four animals were pooled in each experiment. The contents of the small intestine were washed out carefully but thoroughly with water, after which the intestine was slit longitudinally and cut into small pieces for extraction. The lipids were extracted from intestinal samples by use of alcohol and of diethyl ether and from intestinal contents by means of diethyl ether after acidification with dilute hydrochloric acid. Purification of the lipid extracts was accomplished by extraction with petroleum ether of the residue obtained after evaporation of the original extracts to dryness under nitrogen. Livers were extracted initially with alcohol, secondly with alcohol-ether, and finally with ethyl ether in a Soxhlet apparatus for twenty-four hours. Purification of the combined alcohol-ether extracts was accomplished by evaporation to dryness under nitrogen and subsequent exhaustive extraction of the residue with boiling petroleum ether.

Phospholipids were estimated by determination of phosphorus[3] and fatty acids by titration after hydrolysis and extraction. In order to isolate fatty acids for radioactivity

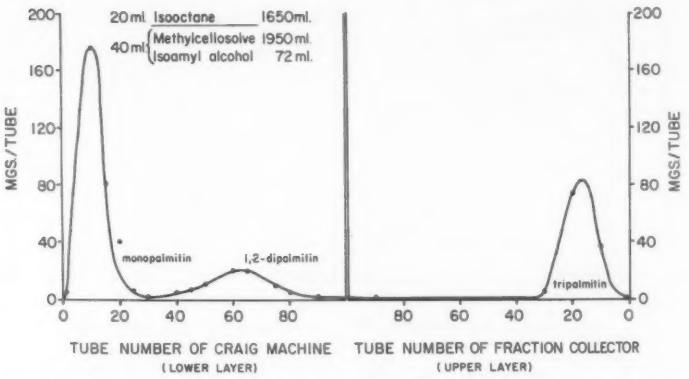

FIG. 1. Countercurrent distribution of a synthetic mixture of 1-monopalmitin, 1,2-dipalmitin and tripalmitin. After 100 transfers had been applied the 100 upper layers were collected in a fraction collector.

determinations various classes of lipids were separated as follows:

Free fatty acids were isolated by alkaline extraction and phospholipids by precipitation with acetone. The glycerides remaining in the extract were separated from each other by countercurrent distribution in an automatic 100-tube Craig apparatus. The solvent systems used were either heptane:methyl cellosolve-isoamyl alcohol[4] or isooctane:methyl cellosolve-isoamyl alcohol. After 100 transfers had been applied the upper layers were collected in a fraction collector. The relative amount of material in upper and lower layers was established by analyses of weight, of radioactivity or of both. When weight analysis was used for location of fractions, correction for free cholesterol was necessary in tubes 30 to 60. The triglyceride peak was found to contain also the esterified cholesterol fraction. Therefore, when liver samples were analyzed the triglyceride peak was fractionated further by use of a silicic acid column according to the method of Fillerup and Mead.[5] The contents of tubes containing a particular fraction were pooled and, after extraction, were hydrolyzed with potassium hydroxide. After acidification the resulting fatty acids were extracted, titrated, and determinations of radioactivity made on barium carbonate obtained by wet combustion of samples and precipitation of carbon dioxide. Counting was done in a windowless counter and corrections were applied for self-absorption. Later samples were counted as fatty acids in a Packard Tri-Carb Liquid Scintillation Spectrometer using diphenyloxazole as primary phosphor, P-bis [2-(5-phenyloxazolyl)]-benzene (POPOP) as secondary phosphor and toluene as solvent. All samples were checked for quenching. Glycerol analyses were done by the method of Lambert and Neish.[6]

RESULTS

The countercurrent distribution patterns of known glycerides* were determined and are shown in Figure 1. Mono- and diglycerides remained in the lower layer. Triglycerides, having high partition coefficients, moved with the advancing upper layer and were collected in the fraction collector, usually in tubes 0 to 35.

A typical countercurrent distribution pattern of glycerides of the small intestine is shown in Figure 2. In this particular sample the rats were killed six hours after feeding C^{14}-palmitic acid. Separations were accomplished in 200 transfers in both isooctane-methyl cellosolve and heptane-methyl cellosolve. The fractions were located by determination of radioactivity of an aliquot from a number of tubes but analyses of weight usually gave

* We are indebted to Distillation Products Industries, Rochester, New York, and the Procter and Gamble Company, Cincinnati, Ohio, for generous samples of pure glycerides.

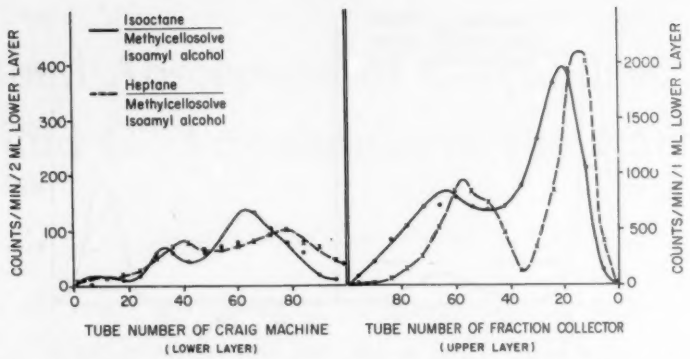

FIG. 2. Countercurrent distribution of glycerides of the small intestine six hours after C^{14}-palmitic acid administration. After 100 transfers had been applied the 100 upper layers were collected in a fraction collector. Analysis was done by radioactivity determination but analysis of weight usually gave similar patterns.

similar patterns (after corrections for free cholesterol in tubes 30 to 60 of lower layer). In these solvent systems cholesterol esters travel in the triglyceride fraction. However, no significant amount of esterified cholesterol was observed in this fraction either from samples of intestine or of intestinal contents. The glycerides of this six-hour intestinal extract were divided into the following fractions: (1) monoglycerides—very small amount of material between tubes 0 and 20 to 25 of lower layer with a fatty acid-glycerol ratio of about 1; (2) diglycerides in tubes 30 to 95 (lower layer) and having a fatty acid-glycerol ratio of about 2; (3) triglycerides found in tubes 0 to 35 of the upper layers with fatty acid-glycerol ratio of approximately 3; and (4) material contained in tubes 40 to 90 (fraction "X") of the upper layer with variable fatty acid-glycerol ratios. Infrared analysis of this material has shown the presence of OH groups of diglycerides but fatty acid-glycerol ratios have varied usually between two and three. Phosphorus has not been detected chemically. This fraction has also been obtained when glycerides from liver lipids have been separated by countercurrent distribution. Only one peak has been obtained in countercurrent extractions of this lipid with as many as 800 transfers applied. However, because of the variable fatty acid-glycerol ratios this fraction may be a mixture of diglycerides and triglycerides. Further work to elucidate its exact composition is now in progress.

TABLE I

Total C^{14} Activity of Lipid Fractions of Intestinal Contents and of Intestine After Feeding C^{14}-Tripalmitin

Lipid Fractions	Intestinal Contents*			Intestine†		
	3 hr.	6 hr.	24 hr.	3 hr.	6 hr.	24 hr.
Free fatty acids	41	62	0	9	16	23
Phospholipid	0	0	0	12	15	16
Monoglyceride	9	2	8	1	0	<1
Diglyceride	9	10	0	4	6	4
"X"	8	5	86	11	10	32
Triglyceride	33	21	6	63	53	25

* Total activity expressed as per cent of total counts in lipids of intestinal contents.

† Total activity expressed as per cent of total counts in lipids of intestine.

The total C^{14} activity present in various lipid classes of intestine and of intestinal contents at three, six and twenty-four hours after feeding C^{14}-tripalmitin is shown in Table I. The results are expressed as per cent of total counts present in intestine and intestinal contents, respectively. Extensive hydrolysis occurred as evidenced by the high activity present at three and six hours in the free fatty acid fraction of intestinal contents. The balance of the activity was largely in tri-

glycerides. At twenty-four hours almost all the activity was present in the unidentified fraction designated "X." In the intestine itself C^{14}-activity accumulated rapidly in triglycerides. Activity was found in free fatty acids even at twenty-four hours but there was almost no C^{14}-activity present as monoglyceride. Although the intestinal contents of these rats did not contain phospholipid, a significant amount of the C^{14}-fatty acids in the intestinal tissue was found associated with phospholipids at all time periods studied.

When C^{14}-palmitic acid was fed instead of tripalmitin, the total activity in the intestinal contents was predominantly in the free fatty acids at both three and six hours after feeding (Table II). However, a considerable amount of C^{14} was found in the triglyceride fraction at these times. In the intestine, initially, the activity was associated largely with triglycerides but at six and twenty-four hours this fraction contained decreasing amounts of C^{14}. Phospholipid fatty acids showed a progressive increase in C^{14} activity from three to twenty-four hours.

The total C^{14} activities of the fatty acids of hepatic lipids of rats killed three hours after feeding C^{14}-palmitic acid or C^{14}-tripalmitin are summarized in Table III. Similar distribution patterns were obtained with the two labeled substrates. Most of the activity was found in the phospholipid fraction with the triglyceride containing almost all of the balance. Diglycerides had about 2 per cent of the total activity and monoglycerides only 0.3 to 0.5 per cent of the total. Fraction "X" also was present in the liver lipids and contained about 4 per cent of the labeled fatty acids. Only 0.7 to 1.5 per cent of the total activity of liver lipids was due to labeled fatty acids esterified with cholesterol.

Although the total activity of liver lipids was predominantly in the phospholipid fatty acids the specific activity of the triglyceride fatty acids was greater than that of the phospholipid fatty acids in both experiments.

TABLE II

Total C^{14} Activity of Lipid Fractions of Intestinal Contents and of Intestine After Feeding C^{14}-Palmitic Acid

Lipid Fractions	Intestinal Contents*		Intestine†		
	3 hr.	6 hr.	3 hr.	6 hr.	24 hr.
Free fatty acids	73	88	8	17	4
Phospholipid	0	0	17	36	74
Monoglyceride	<1	1	<1	<1	—
Diglyceride	7	1	4	2	3
"X"	1	4	9	24	4
Triglyceride	18	6	62	21	15

* Total activity expressed as per cent of total counts in lipids of intestinal contents. Not enough material was present in twenty-four-hour samples to permit lipid fractionation.

† Total activity expressed as per cent of total counts in lipids of intestine.

COMMENTS

Countercurrent distribution technic has been shown to be an effective method for the separation of mono-, di- and triglycerides.[4] In the present study this technic has been combined with other more common chemical separations to fractionate lipids of intestine, intestinal contents and liver during and following the period of absorption. In addition to the three general groups of glycerides (mono-, di- and triglycerides) one other well defined peak was obtained in all samples subjected to countercurrent distribution This lipid group migrated at a slightly slower rate than the

TABLE III

Radioactivity of Fatty Acids Derived from Liver Lipid Fractions of Rats Fed C^{14}-Palmitic Acid or C^{14}-Tripalmitin Three Hours Prior to Sacrifice

Derivation of Fatty Acids	Total C^{14} Activity (% of total activity in total fatty acids of liver)	
	Rats Fed C^{14}-Palmitic Acid	Rats Fed C^{14}-Tripalmitin
Phospholipids	57	50
Monoglycerides	0.3	0.5
Diglycerides	2	2
Triglycerides	37	42
Cholesterol esters	0.7	1.5
Fraction "X"	3	4

triglycerides and faster than the diglycerides. Because of the presence of the OH radical shown by infrared analysis and because fatty acid-glycerol ratios usually were in the region of 2:1 to 3:1 it is assumed that this fraction is a mixture of di- and triglycerides. In some samples the specific activity of the fatty acids obtained by hydrolysis of this material was similar to that of the free fatty acids, but alkaline extraction did not remove the activity. Because ethyl esters of fatty acids have a partition coefficient similar to the material in this fraction the possibility that fatty acids might esterify with ethyl alcohol during the process of extraction was tested. Non-radioactive intestines were extracted by the usual procedure in the presence of C^{14}-ethyl alcohol. The glycerides were then fractionated and fraction "X" tested for C^{14} activity. A negligible count was obtained. Experiments being conducted presently will establish whether or not fed oleic acid-1-C^{14} results in accumulation of C^{14} activity in this fraction.

The results of the C^{14}-tripalmitin feeding experiment indicate that extensive hydrolysis of triglycerides occurred in the intestine of the rat. The accumulation of C^{14}-triglycerides in the intestine three hours after feeding indicates the rapid synthesis of triglycerides from lower glycerides or fatty acids or the absorption of triglycerides as such or both. Exact interpretation of the data is complicated by the added factor of passage of the absorbed lipids into the lymph. Twenty-four hours after feeding C^{14}-tripalmitin, when very little material was found in intestinal contents, considerable C^{14} activity was still present in the intestine in several lipids, including free fatty acids, phospholipids, triglycerides, and fraction "X." When C^{14}-palmitic acid was fed, a much larger percentage of the activity accumulated in the phospholipids by the end of the twenty-four–hour period. During this time the activity in the triglycerides decreased in about the same proportion. It is apparent from these data that synthesis of phospholipids occurs to a significant extent when large amounts of free fatty acids are entering the intestine. According to the findings of Weiss and Kennedy[7] the diglycerides form a common intermediate for triglycerides and for phospholipids in liver tissue. In our experiments much more C^{14} activity was found in diglycerides than in monoglycerides of the intestine. Absorption experiments performed by Johnston[1] revealed that of the labeled glyceride fatty acids in intestinal wall 11 per cent were diglycerides. No activity was found in the monoglyceride fraction. Skipski, Morehouse and Deuel[2] found a significant amount of monoglyceride in intestinal tissue of rats fed a labeled triglyceride or a labeled monoglyceride. Their data indicated that the monoglyceride (1-monodeuteriostearyl glyceride-C^{14}) was absorbed as a unit. It is known that the intestinal lymph contains largely triglycerides with minor amounts of phospholipid and free fatty acids but does not contain mono- or diglyceride.[8–10] Data obtained in our experiments at three, six and twenty-four hours indicate that absorbed fatty acids are present in intestine at these times not only in the form of triglycerides and phospholipids but also diglycerides and to a very slight extent monoglycerides. Since mono- and diglycerides are not found in lymph, these amounts found in the intestinal wall must be converted completely into triglycerides or into phospholipids before leaving the intestine.

When C^{14}-palmitic acid was fed there was considerably more activity in the phospholipids of the intestine than when C^{14}-tripalmitin was used. At six and twenty-four hours after feeding there was more C^{14} activity in the phospholipid fatty acid fraction than in the triglyceride fatty acid fraction. These results indicate that a considerable portion of free fatty acids entering the intestinal cell can be converted to phospholipids. The specific activity of the phospholipid fatty acids in those samples was higher than that of triglyceride fatty acids. In studies of absorption of oleic and palmitic acids in man Blomstrand and Ahrens[10] found more labeled absorbed acids in neutral fats than in phospholipids in the lymph. The possibility exists that even though labeled absorbed fatty acids were incorporated into intestinal phospholipids in considerable quantities in our studies, transfer to lymph was slow in comparison to transfer of triglycerides.

The finding of extensive labeling of triglyc-

eride and diglycerides in intestinal contents after feeding free C^{14}-palmitic acid indicates considerable incorporation of free palmitic acid into glyceride fatty acids within the intestinal lumen. These data confirm findings reported by Borgstrom.[11] Johnston[1] found labeled glycerides on the mucosal side of intestinal strips when incubated with C^{14}-palmitic acid accessible to mucosal side. It was suggested that this was due to sloughing of mucosal cells during incubation, but mention was also made of the possibility of absorption of fatty acids into the intestinal wall with synthesis to glycerides and secretion in part into the mucosal compartment. The exact mechanism responsible for the appearance of C^{14} in glycerides of intestinal contents in our experiments with C^{14}-palmitic acid cannot be ascertained from our data.

In the three-hour absorption experiments hepatic lipids were fractionated and C^{14} activity was found not only in the usually reported fractions such as triglycerides, phospholipids and cholesterol esters but also in monoglycerides and diglycerides. The origin of the latter two lipid classes is not known, but it is of interest that Mead and Fillerup[12] have found as much as 20 per cent of newly ingested fatty acids present in plasma as mono- and diglycerides.

SUMMARY

C^{14}-palmitic acid or C^{14}-tripalmitin has been fed to rats and distribution of the C^{14} in various lipids of intestine, of intestinal contents and of liver determined. Mono-, di- and triglyceride as well as free fatty acid fractions of intestinal contents were found to contain C^{14} activity during the period of absorption. Most of the activity, however, resided in free fatty acids and triglycerides. At this time the triglycerides of the intestine had the predominant labeling and the mono- and diglycerides had the least.

When free palmitic acid was fed much more of the activity was found in the free fatty acid fraction of intestinal contents but considerable activity was also found in diglycerides and triglycerides. Initially, triglycerides of the intestine had the predominant labeling but as absorption proceeded this activity decreased with a concomitant increase in labeling of the phospholipid fraction. Monoglycerides had insignificant C^{14} activity at all times.

Total C^{14} activity measured three hours after feeding either C^{14}-palmitic acid or C^{14}-tripalmitin was greater in phospholipids than in triglycerides of hepatic lipids. However, the specific activity of the triglyceride fatty acids was higher than that of phospholipid fatty acids. Small but significant amounts of C^{14} were also found in mono- and diglycerides as well as cholesterol esters of hepatic lipids.

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Some Hematologic Changes in Patients Receiving Multiple Intravenous Infusions of Fat Emulsion

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THE OCCURRENCE of anemia in laboratory animals[1–6] and in human beings[7–9] receiving long term intravenous infusions of fat emulsions has been reported. However, little is known concerning its cause.

The present work was undertaken as the first phase of a study to determine the etiology of this anemia. A group of schizophrenic patients, apparently physically well, were given daily infusions of 500 ml. of Lipomul®§ for a period of twenty to twenty-nine days. The change in the hematogram was determined at weekly intervals. The anemia which developed was of the hypochromic or hypochromic-microcytic type.

MATERIALS AND METHODS

Lipomul, a 15 per cent cottonseed oil emulsion containing 4 per cent glucose, 1.2 per cent purified soybean phosphatides and 0.3 per cent Pluronic F68, was used throughout.

The subjects were six male and one female schizophrenic patients who had been institutionalized for periods of from ten months to ten years and eight months. Their ages ranged from twenty-eight to forty-five years and body weights were from 43.2 to 71.8 kg. All patients were ambulatory and without any apparent physical disease. They were on a regular hospital diet with approximately 73 to 86 gm. protein, 82 to 112 gm. fat, 252 to 331 gm. carbohydrate and 2,161 to 2,485 calories offered daily. The amounts of vitamins A and C, thiamine, riboflavin, niacin and minerals, including iron, were equal to or higher than the recommended dietary allowances.¶ Most of the patients were receiving tranquilizers. Each patient was given 500 ml. of Lipomul daily on consecutive days except in one case (patient E. H.) where there was an interval of two days between infusions. Six of the patients received a total of thirty-one to thirty-three infusions while the other was given twenty-four (Table I).

Precautions were taken to start the infusions at a slow rate of approximately 1 to 2 ml. per minute for the first thirty minutes, after which the rate was increased so as to finish a bottle of 500 ml. in a total of three to three and a half hours. The first infusion of the series was only 300 to 400 ml. and the volumes of the final four infusions were progressively reduced to 150, 100, 50 and 50 ml.

Blood samples were drawn at weekly intervals about twenty hours after the preceding infusion. Blood hemoglobin was determined

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§ Lipomul, I.V. (Lot Nos. 11-612-72, 11-612-74, KG508 and KG509), was kindly supplied by the Upjohn Co., Kalamazoo, Michigan.

¶ The intakes of nutrients are calculated from the menus. The authors wish to express their appreciation to Misses Bernice Hopkins and Emily Stanley of the Dietetic Department, Vanderbilt University Hospital, Nashville, Tennessee, for these calculations.

TABLE I
Condition of Patients* and Amounts of Lipomul Given

Patient, Sex and Age (yr.)	Initial Weight (kg.)	Height (in.)	Medication (mg./day)	Length of Hospitalization (yr.)	Total Lipomul Infused	
					No. of Infusions†	Total Volume (ml.)
N. K., M, 39	50.0	70	None	3¾	31	13,850
W. W., M, 33	55.0	68	Stelazine (10–20)	9⅔	31	13,850
R. R., M, 28	54.1	67	Compazine® (30)	4⅙	24	10,350
R. J., M, 43	43.2	66	Stelazine (10–20)	⅘	32	14,350
G. D., M, 40	55.5	67	Dartal® (20)	10⅔	33	14,850
M. D., F, 45	50.0	66	Thorazinex (75)	6¼	28	14,000
E. H., M, 29	71.8	74	Vesprin® (25–50)	1½	32	13,350

* All patients are schizophrenics.
† Number of infusions include four "tapering off" infusions in all patients except M. D.

by the method of Evelyn and Malloy.[10] Red and white blood cells and reticulocytes were counted by the standard procedures and the hematocrit was obtained by centrifuging the oxalated blood in a Wintrobe tube for half an hour at 2,500 revolutions per minute.

Blood volume was estimated at intervals during the infusion period by the method of radioactive I^{131}-labeled serum albumin;[11] the radioactivity of whole blood was determined. The plasma volume and red blood cell mass were calculated from the blood volume and hematocrit.

RESULTS

General Condition of the Patients: The condition of the patients receiving infusions of Lipomul will be published in detail elsewhere.[12] It can be noted here that the fat emulsion did not cause immediate thermogenic or other reactions in any patient. A gain in body weight of 0.5 to 3.7 kg. was observed in all patients but one, who showed no change. In two patients delayed reactions of moderate (M. D.) or mild (R. J.) severity occurred. Hemorrhagic episodes were not observed.

Development of Anemia: Table II shows the changes in hemoglobin, hematocrit, erythrocyte and reticulocyte counts and erythrocyte indices of all patients. A progressive reduction in hemoglobin occurred in all patients except subject E. H. who showed no significant change after four weeks of daily infusions of Lipomul. The decrease in hemoglobin was over 20 per cent of the control values in two patients (N. K. and R. J.), greater than 15 per cent in three (W. W., R. R. and G. D.), while only 6.8 per cent in one (M. D.).

The decrease in hematocrit after three to four weeks of Lipomul infusions was approximately equivalent to that of hemoglobin in three patients (N. K., W. W. and R. R.), but was less in two (R. J. and G. D.) and more in one (M. D.). The decrease ranged from 10.1 to 24.3 per cent of the preinfusion levels. There was no significant change in the hematocrit of patient E. H.

The erythrocyte counts of all patients except E. H. also were reduced. However, the reduction was 10 per cent or less of the preinfusion levels in four of the six subjects (N. K., W. W., R. R. and G. D.), while the decrease was 13.1 and 16.0 per cent in patients M. D. and R. J., respectively.

Hemoglobin, hematocrit and erythrocyte count were further reduced in patient M. D. when a delayed reaction characterized by chill, fever and anorexia was encountered.

A decrease in mean corpuscular hemoglobin (MCH) was found in five patients (N. K., W. W., R. R., R. J. and G. D.). Of these, three showed an approximately equivalent reduction of mean corpuscular volume (MCV), but no change in mean corpuscular hemoglobin concentration (MCHC) (N. K., W. W. and R. R.); in the other two patients, the

TABLE II—Changes in Hemogram and Blood Volume

No. of Infusions	Date (1958)	Red Blood Cell Count (millions)	Hemoglobin (gm.)	Hematocrit (%)	Mean Corpuscular Volume	Mean Corpuscular Hemoglobin	Mean Corpuscular Hemoglobin Concentration	Reticulocytes (%)	Blood Volume (ml.)	Plasma Volume (ml.)	Red Cell Mass (ml.)	White Blood Cell Count (millions)
					Patient N. K.							
0	11/20	3.98	13.5	29.5	99.2	33.9	34.2	0.6	—	—	—	7,500
7	11/26	4.17	12.5	39.5	94.7	30.0	31.6	0.6	4,043	2,446	1,597	6,300
14	12/4	4.18	—	35.9	85.9	—	—	0.9	—	—	—	7,000
21	12/11	3.93	11.8	36.0	91.6	30.0	32.8	0.7	4,020	2,573	1,448	5,500
28	12/19	3.75	10.4	29.9	79.7	27.7	34.8	0.6	4,316	3,026	1,290	5,150
% Δ after 28 infusions		− 5.8	−23.0	−24.3	−19.6	−18.3	1.8	...	6.8	23.7	−19.2	−31.3
					Patient W. W.							
0	10/10	4.07	13.5	41.9	102.9	33.2	32.2	0.9	—	—	—	9,350
7	10/16	—	12.5	40.0	—	—	31.2	0.8	4,563	2,738	1,825	—
14	10/23	4.10	12.3	39.0	95.1	30.0	31.5	0.8	—	—	—	5,350
21	10/30	4.01	11.1	35.6	88.8	27.7	31.2	0.9	4,607	2,967	1,640	4,650
27	11/6	3.70	11.1	35.0	94.6	30.0	31.7	—	—	—	—	4,250
% Δ after 27 infusions		− 9.1	−17.8	−16.5	− 8.1	− 9.6	−1.6	...	1.0	8.4	−10.1	−54.5
	1/16/59	4.38	11.4	33.0	75.3	34.5	34.5	...	...	...	...	7,500
					Patient R. R.							
0	10/17	5.45	16.3	49.0	89.9	29.9	33.3	0.9	4,376	2,232	2,144	8,900
7	10/23	5.62	14.9	45.0	80.1	26.5	33.1	0.9	...	...	...	5,700
14	10/30	4.87	13.5	40.5	83.2	27.7	33.3	0.9	4,670	2,779	1,891	5,450
21	11/6	5.06	13.8	41.8	82.6	27.3	33.0	...	...	...	...	5,050
% Δ after 20 infusions		− 7.2	−15.3	−14.7	− 8.1	− 8.7	−0.9	...	6.7	24.5	−11.8	−43.2
					Patient R. J.							
0	9/17	4.80	14.7	42.8	89.2	30.6	34.3	1.4	...	...	...	14,950
7	9/25	4.30	13.4	40.9	95.0	31.2	32.8	1.0	4,230	2,500	1,730	8,725
14	10/2	4.56	13.5	40.0	87.7	29.6	33.8	0.9	...	...	...	7,550
21	10/9	4.03	11.4	36.0	89.3	28.3	31.7	1.0	3,682	2,356	1,326	6,850
% Δ after 21 infusions		−16.0	−22.4	−15.9	0.1	− 7.5	−7.6	...	−13.0	− 5.8	−23.4	−54.4
28	10/16	...	...	34.2	...	...	...	1.0	...	...	...	...
	10/30*	4.24	10.8	33.8	79.8	25.5	32.0	...	...	...	...	4,950
	1/16/59	4.87	13.9	42.0	86.2	28.5	30.5	...	...	...	...	10,450
					Patient G. D.							
0	9/10	4.64	12.1	37.5	80.8	26.1	32.3	0.9	...	...	...	11,825
7	9/17	4.34	11.8	36.7	84.6	27.2	32.2	0.7	...	...	...	13,775
14	9/25	4.10	11.4	35.0	85.4	27.8	32.6	0.8	4,577	2,975	1,602	6,625
21	10/2	3.88	11.4	34.8	89.7	29.4	32.8	0.9	...	...	...	10,900
29	10/9	4.17	10.0	33.7	80.8	24.0	29.7	0.8	4,008	2,657	1,351	8,800
% Δ after 29 infusions		−10.1	−17.4	−10.1	0.0	− 8.0	−8.0	...	−12.4	−10.7	−15.7	−25.6
	1/16/59	4.44	13.4	39.2	88.3	30.2	34.0	...	...	...	...	9,200
					Patient M. D.							
0	7/9	4.05	10.3	34.2	84.4	25.4	30.1	...	...	...	...	9,250
7	7/16	5.03	11.3	35.8	71.2	22.5	31.6	...	...	...	...	7,050
14	7/24	4.51	10.0	33.0	73.2	22.2	30.3	...	...	...	...	9,700
21	7/30	3.40	10.1	31.0	91.2	29.7	32.6	...	...	...	...	8,100
28	8/6	3.52	9.6	30.0	85.2	27.3	32.0	...	...	...	...	9,250
% Δ after 28 infusions		−13.1	− 6.8	−12.3	0.9	7.5	6.3	...	...	...	...	0
	8/11†	3.06	8.5	27.3	89.2	27.8	31.1	...	...	...	...	4,325
					Patient E. H.							
0	11/20	4.37	11.8	40.0	91.5	27.0	29.5	0.6	...	...	...	5,600
7	11/26	4.48	13.2	42.5	94.9	29.5	31.0	0.8	5,294	3,044	2,250	7,000
14	12/4	3.94	12.4	39.5	100.2	31.5	31.5	0.7	...	...	...	7,250
21	12/11	3.98	12.2	39.2	98.5	30.6	31.1	0.7	5,880	3,575	2,305	5,800
28	12/19	4.38	12.1	39.2	89.5	27.6	30.9	0.8	5,321	3,235	2,086	6,350
% Δ after 28 infusions		0.2	2.5	− 2.0	− 2.2	2.2	4.7	...	0.5	6.3	−7.3	13.4

* Determinations made during the recovery phase fron a very mild delayed reaction.
† Determinations made during a delayed reaction.

TABLE III
Mean Percentage Changes in Hemogram*

Data	Red Blood Cells	Hemoglobin	Hematocrit	Mean Corpuscular Volume	Mean Corpuscular Hemoglobin	Mean Corpuscular Hemoglobin Concentration
After 7 infusions	3.2	− 4.2	− 2.9	−1.2	−5.7	−1.9
After 14 infusions	−1.7	− 8.6	− 8.4	−6.3	−5.8	0
After 21 infusions	−9.7	−12.6	−11.9	−1.7	−2.5	−1.0
After 28 infusions	−9.5	−16.2	−15.8	−6.7	−6.7	−0.4

* Patient E. H. was not included in the average since his hemogram did not show any significant change.

mean corpuscular hemoglobin concentration was also reduced (R. J. and G. D.). The mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration of patient M. D. were increased while those of E. H. showed no significant changes.

Reticulocytosis did not occur during the entire period of Lipomul infusion.

Follow-up studies of patients W. W., R. R., R. J. and G. D. indicated that the recovery from anemia was slow and the blood findings required three months to return to the preinfusion levels. This was especially true with regard to hemoglobin concentration and hematocrit. Thus, the hemoglobin and hematocrit were still at low levels approximately two and a half months after the termination of infusions in patients W. W. and R. R. (Table II).

The weekly mean percentage changes in the hemograms are summarized in Table III. After one week of infusions, the changes were variable among individual patients and the mean changes were not significant. After two or more weeks, however, the pattern of change became quite consistent and the means were significant.

Changes in Leukocyte Count: A progressive decrease in leukocyte counts was found after three to four weeks of daily infusions (Table II) in all patients but E. H. and M. D. The decreases ranged from 25.6 to 54.5 per cent of the preinfusion levels. In patient M. D., however, leukopenia was demonstrated at the time of her illness five days after the last infusion.

Blood Volume: Blood volume was estimated at intervals in six of the seven patients. Four patients (N. K., W. W., R. R. and E. H.) showed no significant change and the other two (G. D. and R. J.) showed a decrease of 12.4 and 13.0 per cent. The plasma volume, calculated from the blood volume and hematocrit, was increased in four patients from 6 to 25 per cent and decreased 6 to 11 per cent in 2. The red blood cell mass was decreased in all six patients from 7.3 to 23.4 per cent.

COMMENTS

The patients in the present study were apparently well physically although their initial control hemograms were somewhat lower than normal in several instances. Our results, therefore, provide further evidence that multiple intravenous infusions of fat emulsions may lead to anemia in man, as reported by other investigators.[7–9]

This anemia is of the hypochromic or hypochromic-microcytic type and it is usually apparent after two weeks of daily infusion and obvious after three weeks. The degree of anemia is such, however, that it does not constitute a contraindication to giving Lipomul for a two-week period. Furthermore, no other untoward effects were encountered within this time interval.

The results of the present study do not provide an explanation for the mechanism of this anemia. However, it is reasonable to believe that (1) the reductions in the hemoglobin, hematocrit and erythrocyte counts were not attributable to hemodilution, although this may have been a contributing factor in

some of the patients. Thus, the decrease in cell mass was much greater than the change in plasma volume in some patients; and the reduction of the hemoglobin concentration greater than that of erythrocyte count in most of the subjects. (2) External or internal hemorrhage was not observed; thus, it is not likely that the anemia was due to blood loss. (3) Our preliminary studies[13] have shown that the serum iron and total iron binding capacity of serum are progressively decreased following long term intravenous infusions of Lipomul. This suggests the presence of a block in the synthesis of hemoglobin. (4) Watkin,[7] Levenson, et al.[8] and Mueller[9] have demonstrated increases in reticulocytes in the peripheral blood accompanying anemia produced by multiple fat infusion. We could not confirm these findings.

SUMMARY AND CONCLUSIONS

1. Seven, apparently physically well, institutionalized schizophrenic patients were given daily intravenous infusions of 500 ml. of a fat emulsion (Lipomul I.V.) for twenty to twenty-nine consecutive days.

2. The emulsion was tolerated well by all patients during the infusion period. Mild to moderate delayed reactions were observed in two patients three to seven days after the last of the infusions was given.

3. A progressive hypochromic or hypochromic-microcytic anemia and leukopenia occurred in six of the seven patients.

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A Nutrition Survey of the Armed Forces of the Philippines

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THE Interdepartmental Committee on Nutrition for National Defense (ICNND) was established in 1955 as part of the United States assistance programs to friendly nations. The aims, purposes and methodology of this coordinated program have been detailed in the report of Berry and Schaefer.[1] During the four years since its inception the Committee has conducted nutrition surveys of military and civilian populations in twelve countries throughout the world, as far south as Peru, as far north as Alaska, and in the Far East and Middle East. The reports of these surveys are available from the office of the Committee.† The 1956 Korean survey has been published.[2] This paper compares data from that study, the present study and others.

In response to a request from the Government of the Republic of the Philippines, a nutrition survey of the Armed Forces of the Philippines was conducted under the auspices of the ICNND. The objective of the survey was to assess the current nutritional status of the armed forces and to identify practical measures for improving the nutritional health of the personnel. This survey was conducted during February and March 1957. As the military personnel of this country are billeted to a large extent with their families, the findings and implications reflect to a large extent the nutritional situation among the adult civilian population.

PHYSIOGRAPHY AND ECONOMY OF THE PHILIPPINES

The Philippine Archipelago consists of over 7,000 islands having a total area of about 115,000 square miles and extends in excess of 1,000 miles from north to south. Only 462 of these islands are 1 square mile or more in area. The two largest, Luzon in the north and Mindanao in the south, account for some 68 per cent of the total land of the Archipelago. Nine other islands, chiefly in the Visayan group, range in area from 1,500 to 5,000 square miles. These are Samar, Negros, Palawan, Panay, Mindoro, Leyte, Cebu, Bohol and Masbate.

The topography of the country varies greatly; mountains, hills and plains are found on nearly all the large islands. Several mountains rise to nearly 10,000 feet, and there are about twenty intermittently active volcanoes. The bulk of the population is found in the plains and interior valleys, the most noteworthy of these being the Central and Bicol plains and the Cagayan Valley in Luzon, the central plain of Panay, and the Agusan and Cotabato

From the Interdepartmental Committee on Nutrition for National Defense of the United States, the Philippine Institute of Nutrition and the Armed Forces of the Philippines.

† Interdepartmental Committee on Nutrition for National Defense, Building 16A, National Institutes of Health, Bethesda 14, Maryland. Tables presented in this paper are abridgments or combinations of those given in the original report of this survey. For the complete presentation of tabular data compiled for this survey the reader is directed to the original report, available from the office of the ICNND.

TABLE I
United States-Philippine Trade in Agricultural Products During 1955

Product	Millions of U. S. Dollars
U. S. Exports to Philippines	
Wheat flour	10.2
Cotton, unmanufactured	2.2
Tobacco, unmanufactured	11.5
Evaporated milk and other dairy products	20.9
Canned meats	2.9
Fruits and vegetables	4.4
Tallow	1.0
Other agricultural products	7.0
Total agricultural products	60.0
Total all commodities	338.4
U. S. Imports from Philippines	
Sugar	109.1
Copra	45.2
Coconut oil	16.3
Shredded coconut	12.1
Copra cake and meal	2.4
Abaca fiber (hemp)	8.0
Pineapples, canned; juice	5.4
Peanuts	1.6
Tobacco	0.7
Other agricultural products	1.4
Total agricultural products	202.2
Total all commodities	251.5

valleys of Mindanao. The major rivers are the Cagayan, Arno and Pampanga on Luzon and the Agusan and the Mindanao-Pulangi on the island of Mindanao.

The climate of the Philippine Islands is characterized by continuous heat, a uniformly high relative humidity, and abundant rainfall. The rainfall varies from place to place and from season to season due to the effects of prevailing winds and topographical variations. Most sections of the Philippines have an annual rainfall of from 50 to 150 inches. The temperature varies within relatively narrow limits, seldom less than 65°F. or more than 95°F. There is a great contrast between the hot, moist summer climate of the central plain of Luzon and the delightfully cool climate of the Luzon highlands near Baguio, the former summer capital of the country. In general, December and January are the coolest months, while April and May are the warmest.

The Filipino people are largely of Malayan stock but many ethnographic groups are represented. The population, estimated at 24,200,000 in 1958, is said to be increasing at the rate of about 2.5 per cent per year.

For administrative purposes the country is divided into fifty provinces and the city of Manila. Each province is composed of a group of municipalities and municipal districts divided into "barrios." A barrio may contain as few as 10 or as many as 1,000 houses ordinarily grouped together to form a village. The chief cities with their 1948 census figures are as follows: Manila, 983,906; Quezon City, 107,977; Cebu City, 77,411; Davao, 47,486; Bacalod, 42,820; and Zamboanga, 17,001.

Although approximately one-third of the people speak English, more than eighty dialects of Indonesian languages are found in the Philippines. The major dialect is Tagalog, established as the national language, and spoken by about one-third of the people. It is the principal language of central Luzon. The other major dialect is Visayan which is spoken in the Visayan Islands and on the northern and eastern coasts of Mindanao. In the 1948 census, a literacy rate of 60 per cent was established for persons over the age of ten years. Public schools are numerous and distributed throughout the country.

Roman Catholicism is the dominant religion; it is estimated that nearly 85 per cent of the population belong to this faith. Approximately 10 per cent are Protestants and some 4 per cent are Moslems. The latter group is concentrated in the southern islands, especially in Mindanao and Jolo.

The economy of the Philippines is based largely upon agriculture. Some 75 per cent of the population is engaged in or dependent upon agriculture, fishing or forestry. The main crops are rice, corn, coconut, sugar cane and abaca (hemp). In addition, fruits, vegetables, root crops and tobacco are grown. The Philippines are largely self-sufficient in production of rice and corn, but wheat flour is imported in quantity. Other food imports include meats, canned fish, coffee and cacao. There are large

exports of sugar, copra, coconut oil and abaca. Roughly half of the land is covered with forests, and the Philippines are one of the world's leading exporters of lumber. The majority of all trade has been and is with the United States, although it is now increasing with other nations, such as Japan. In 1956 it was estimated that about 60 per cent of the country's trade was carried on with the United States. Free trade with the United States existed until 1956, but has now been replaced by a policy of low tariff barriers which will be increased gradually to the full rate by 1974. This policy is certain to have a far-reaching effect upon the composition of the Philippine market and the proportion of trade with the United States. Table I shows the extent of the trade in agricultural products in 1955.

Filipino agriculture is characterized by small subsistence-type farms with an average size of less than 10 acres. Of all farms 53 per cent are owner-operated while part owners account for another 10 per cent. About three fourths of the area under cultivation is planted in subsistence food crops and the remainder in commercial crops, mostly for export. Scientific farming, soil fertilization and product standardization are practiced infrequently. Carabaos (water buffaloes) are the chief source of "work" power for farming. Dairying is limited. Some hogs and poultry are raised, but fish are the main source of animal protein in the Filipino diet.

In recent years agricultural production has been increasing somewhat faster than the rate of population growth. It is expected that the country will soon be fully self-sufficient in the production of rice. The production of copra, corn, coffee, cocoa and tobacco has increased, and this rise is expected to continue. The Food and Agriculture Organization food balance sheet of the different kinds of food available for consumption per capita in 1951 and 1952, and the food balance data of the U. S. Department of Agriculture Foreign Agricultural Service for 1954 and 1955 are presented in Tables II and III, respectively.

The Filipino diet contains a preponderance of rice—in fact, this cereal supplies nearly half the total calories. Corn is the other cereal locally grown. Wheat is largely imported. The sweet potato is the tuber grown in greatest amounts, followed by cassava. White potatoes are almost non-existent. The bean most commonly consumed is the mung bean or mungo bean (*Phaseolus aureus*), known locally as the "mongo." Vegetables are available in relatively small quantities. These are tomatoes, eggplant, the pods of cowpeas (*Vigna sinensis*) and mongos and squash. The most popular leafy vegetables are cabbage and mustard.

TABLE II

Food Balance Sheet, Philippines, 1951–1952*

(Amount of Each Food Available for Consumption per Person per Day)

Food	Amount Available (gm.)	Group Total (gm.)	Estimated Calories
Cereals:			
Rice	248.0	...	...
Corn	75.6	...	...
Wheat (flour)	29.2	...	...
Other grain products	1.5	354.3	1,275
Roots, tubers, etc.:			
Potatoes	1.3	...	...
Sweet potatoes	73.3	...	...
Cassava	33.8	...	...
Gabe, Tugue Ubi	37.6	146.0	141
Sugar:			
Refined	44.6	...	...
Crude	16.2	60.8	230
Pulses and nuts:			
Peanuts	2.5	...	...
Mongo	3.5	...	...
Coconuts	43.1	...	...
Others	5.1	54.2	49
Fruits:			
Bananas	119.2	...	...
Citrus	3.2	...	...
Other fruits	160.3	...	...
Dried fruits	0.1	282.8	152
Vegetables	31.0	...	7
Meat	12.6	...	28
Eggs	5.1	...	7
Fish:			
Fresh and frozen	40.0	...	...
Dried and salted	0.6	...	...
Canned	5.8	46.4	36
Milk and cheese	9.3	...	19
Fats and oils:			
Coconut oil	20.0	...	...
Other vegetable oils	0.05	...	...
Butter	1.04	...	...
Animal fat	0.25	21.34	187
Total			2,131

* Prepared for FAO, 1952.[12]

TABLE III
Philippines Food Balance Data, 1954–1955

Product	Reported Production*	Estimated Supply	Net Trade (1,000 metric tons)		Total Supply	Domestic Disappearance			
						Non-food Uses†	Available for Food‡		
							Total	Per Capita	
			Imports	Exports				Per Year (kg.)	Per Day (cal.)
Grains:									
Rice, milled	2,135	2,060	36	...	2,096	110	1,986	91.1	899
Corn	957	804	16	...	820	40	780	35.8	349
Wheat flour	...	5	188	...	183	...	183	8.4	80
Pulses:									(1,328)
Beans	51	37	...	...	37	1	36	1.7	16
Peas	...	22	1	...	23	1	22	1.0	10
Other	...	20	1	...	21	...	21	1.0	9
Roots, tubers and starches:									(35)
Sweet potatoes	700	800	...	...	800	159	641	29.4	85
Cassava	350	352	...	...	352	106	246	11.3	30
Gabi	...	162	...	...	162	32	130	6.0	13
White potatoes	...	15	1	...	16	3	13	0.6	1
Other	...	150	...	...	150	15	135	6.2	14
Sugar:									(143)
Centrifugal	1,275	1,103	...	883	220	...	220	10.1	107
Non-centrifugal	90	90	...	...	90	...	90	4.1	40
Oilseeds:§									(147)
Copra‖	1,077	1,257	...	770	487	233	754	11.7	203
Peanuts, shelled	12	18	...	4	14	2	12	0.6	8
Soybeans	...	...	3	...	3	...	3	0.1	1
Oils and fats:¶									(212)
Coconut oil	...	147	...	67	80	34	46	2.1	51
Other	...	25	1	...	26	...	26	1.2	29
Vegetables:									(80)
Cabbage	...	258	...	...	258	26	232	10.6	5
Eggplant	...	88	...	...	88	9	79	3.6	2
Other	...	400	16	...	416	42	374	17.2	9
Fruit:									(16)
Bananas	...	1,000	...	...	1,000	100	900	41.3	67
Mangoes	...	115	...	1	114	12	102	4.7	6
Citrus	...	61	5	...	66	6	60	2.8	2
Pineapple	...	113	...	86	27	5	22	1.0	1
Other	...	346	6	...	352	35	317	14.5	20
Meat:									(96)
Pork	...	185	...	...	185	...	185	8.5	72
Poultry	...	60	...	...	60	...	60	2.8	13
Carabao	...	50	...	...	50	...	50	2.3	7
Beef and veal	...	35	7	...	42	...	42	1.9	9
Mutton and goat	...	10	...	...	10	...	10	0.5	2
Other	...	10	5	...	15	...	15	0.7	2
									(105)
Fish	...	500	23	...	523	...	523	24.0	(56)
Milk	...	400	150	...	550	...	550	22.2	(47)
Eggs	...	56	...	...	56	...	56	2.6	(10)
Total									2,275

NOTE: Figures in parentheses represent totals.

Footnotes on opposite page. ⟶

About half the fruit produced consists of bananas. The remainder includes mangoes, papaya, cantaloupe, watermelon, avocados and pineapples. Pork is the most commonly available meat, followed closely by poultry. Meat of the carabao, once popular, is now used in but limited quantity, due to a postwar governmental edict forbidding slaughter of these animals for food, in order that the depleted herds might be increased for agricultural use. Eggs of both duck and chicken are consumed. A fat made of a mixture of coconut and cottonseed oils is in general use. Only small amounts of butter or margarine are available.

Industrialization aimed at making the Islands more self-sufficient in manufactured goods is a goal emphasized in the Philippine economy. The bulk of manufacturing now deals with the processing of raw materials for export and the production of small commodities for domestic consumption. Sugar cane, fibers, coconuts, minerals and timber are processed for export. Products of the embroidery industry, pineapple canning and manufacturing of pearl buttons are also primarily for export. Several industries are devoted to manufacturing for domestic consumption. These include lumber and rice mills; textile and cement plants; cigar, cigarette and shoe factories; vegetable, margarine and lard plants; and a paper mill. A variety of small articles are also manufactured.

The development of heavy industry has been slow, as most machinery and raw materials have to be imported. Little coal and oil are produced in the Islands which presents a serious detriment to the continued expansion of heavy industry. However, water power offers a great potential source of electricity, and new projects in Mindanao and Luzon are being developed to improve the power situation.

Heavy industries currently operating are a petroleum refinery, a fertilizer plant, a steel mill and plants for assembling storage batteries, automobiles, trucks and farm tractors and implements. Two United States oil companies are building large refineries in the Luzon area and an American rubber company has recently completed a nine million dollar tire factory in Manila. It is hoped that rubber acreage in the Philippines will eventually make the latter concern independent of rubber imports.

HEALTH AND MEDICINE IN THE PHILIPPINES

In 1955 the Philippine Department of Health was decentralized by law into regional offices in order to put the unit of authority close to the people to be served by Provincial and City Health Departments and more Rural Health Centers. Not less than 1,300 of the latter were to be established by 1958. The Undersecretary for Health and Medical Services, in addition to having jurisdiction over the regional offices, oversees the work of the Bureaus of Health Services, Disease Control and Medical Services. The Undersecretary for Special Health Services is responsible for the work of the Bureau of Quarantine and the Bureau of Research and Laboratories. Twelve members of a National Advisory Board of Health aid and counsel the Secretary of the Department of Health. Health education and personnel training are the responsibility of an office of that title under the Secretary's jurisdiction.

Most of the country's water supply comes from drilled or dug wells. Manila and several other large cities have adequate sewage disposal. However, water is unsafe to use unless it is boiled or otherwise disinfected. Parasitie infestations are prevalent, as are infectious diseases. Gastrointestinal diseases are among

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* Production figures obtained through an authenticated source are frequently incomplete, because they often do not include food production for home use, and also because of under-reporting of commercial crops due to unreliable methods of crop census taking, and sometimes, in order to escape or reduce possible assessments for government revenue.

† Non-food uses are for seed, feed, waste and industrial uses.

‡ Figures under this heading refer to food consumed. They are not necessarily identical with amounts of food available for consumption because not all planted food crops are harvested, nor are all foods growing wild gathered.

§ Includes oilseed used in the manufacture of oil which is deducted under the column, "non-food uses." Oil derived from oilseeds reappears under the heading, "Oils and Fats."

‖ Coconuts expressed in terms of copra.

¶ Extraction rate applied as follows: copra, 63 per cent.

Prepared by the Foreign Agricultural Service, United States Department of Agriculture 1955.

TABLE IV*
Leading Causes of Morbidity and Mortality in the Philippines
(Number and Specific Rates per 100,000 Population)†

	1953				1954				1955			
	Cases		Deaths		Cases		Deaths		Cases		Deaths	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Respiratory tuberculosis	48,079	230.69	25,101	120.44	52,141	246.27	23,491	110.91	71,448	332.03	23,192	107.78
Beriberi	38,251	183.53	24,222	116.22	39,560	186.78	23,306	110.04	53,672	249.42	22,055	102.49
Bronchopneumonia	33,257	159.57	24,494	117.52	30,626	144.60	20,023	94.54	35,179	163.48	19,156	89.02
Bronchitis	62,375	299.28	22,626	108.56	74,698	352.68	19,192	90.61	140,428	652.59	17,546	81.54
Gastric enteritis and colitis except ulcer	49,400	237.03	17,187	82.46	52,711	248.87	13,842	65.36	107,634	500.19	13,463	62.56
Malaria	54,119	259.67	6,720	32.24	71,363	336.93	5,236	24.72	79,707	370.41	3,714	17.26
Pneumonia	9,429	45.24	7,284	34.95	9,001	42.50	6,561	30.98	10,572	49.13	6,173	28.69
Influenza	28,474	136.32	4,515	21.66	58,344	275.47	4,200	19.83	64,608	300.24	3,361	15.62
Tuberculosis of other organs	1,969	9.45	1,625	7.80	1,956	9.24	1,381	6.52	2,321	10.79	1,396	6.49
Cancer	2,503	12.00	2,404	11.53	2,585	12.20	2,553	12.05	2,836	13.18	2,786	12.95

* Table furnished by the Republic of the Philippines, Department of Health, Bureau of Health, Manila.
† Arranged as to magnitude of mortality in 1950.

the leading causes of death in infants (Table IV).

The average life expectancy in the Philippines has increased from eighteen years in 1900 to between forty-two and fifty-four years at the present time. The birth rate per thousand individuals increased from 28.87 in 1946 to 33.17 in 1954, while the death rate decreased from 15.08 per thousand in 1946 to 10.28 in 1954. Infant mortality per thousand live births dropped during the same period from 125.45 to 94.18. These figures must be accepted with some reservation, since there is probably under-registration of both births and deaths. The same applies to the causes of death reported, the figures for which are affected by occasional lack of competent medical diagnosis as well as by under-reporting.

A malaria control project was begun in 1953, with widespread spraying of the breeding places of the Anopheles mosquito continuing to the present time. In 1953 a schistosomiasis control program was also begun. BCG vaccinations to control tuberculosis have been given since 1948.

There is one medical doctor to about every 9,000 persons in the Philippines, but many of these are disproportionately congregated in the cities. Furthermore, it is estimated that only about 70 per cent of them practice medicine. Medical specialities are not well advanced. Those who have been trained abroad find few opportunities on their return to practice at the level for which they have been fitted. There is a similar shortage of nurses in many areas.

Medical education is centered in Manila where there are three medical schools. Two of these, the University of the Philippines and the University of Santo Tomas, together graduate about 275 doctors each year. As the population is increasing due to higher birth rates and lower death rates, the need for more doctors will continue for some time.

There are at present approximately 80 government hospitals and 212 private hospitals in the Philippines.

NUTRITION

Malnutrition has always been a vexing problem in rice-eating areas. The Philippines have been no exception. Beriberi, particularly in infants, has been a pressing problem since the early descriptions of Guerrero and Quintos,[3] and Albert[4]; even today[5–7] it ranks high as a cause of death. Vedder's classic monograph[8] on beriberi resulted from his experience in the region, and Williams' contributions[9] sprang

from his early introduction by Vedder to the subject as an impressionable young scientist in the Philippine Islands.

According to the vital statistics assembled by the Philippine Department of Health, the main cause of death is respiratory tuberculosis followed closely by beriberi. The 1955 statistics show the death rate per 100,000 from tuberculosis as 107 and from beriberi as 102.[10] About two-thirds of the deaths recorded are in infants. The recorded mortality from beriberi varies considerably from province to province and from year to year. For example, deaths per 100,000 population attributable to this disease in 1955 ranged from 12.9 in Sulu to 253.9 in Isabela Province.

At present some uncertainty exists concerning the accuracy of data on the incidence of beriberi in the Philippines. Part of this uncertainty stems from the fact that beriberi has never been declared a notifiable disease, part of it is due to the difficulty of verifying diagnoses of deaths from infantile beriberi. Salcedo et al.[11] expressed the opinion that there tends to be an under-reporting of this disease, and a joint Food and Agriculture Organization/World Health Organization team[12] concur in this conclusion. On the other hand, Stransky[13] states that "not so long ago thiamine deficiency was rampant in the Philippines, now it has become so rare that we have difficulty showing a single case to the medical students every year." He did not record a single case of beriberi in 269 random admissions of malnourished children to the Philippine General Hospital in Manila (1950, 1951 and 1952) but twenty-six diagnoses of kwashiorkor were recorded. Stransky believes that the most common deficiencies seen in Filipino children today are those of protein, iron, riboflavin, vitamin D and vitamin A. It is doubtful, however, that studies of hospital admissions can be extrapolated to the entire population, and it is evident that clarification is needed of the problems of malnutrition among infants and children in the country.

At least twenty nutrition surveys have been carried out in the Philippines between 1909 and 1952. Suffice it here to discuss only the more recent ones.

Nutrition surveys were made in Bataan Province in 1948 and 1950, before and after the introduction of enriched rice into this area.[11,14] The level of enrichment used supplied 2 mg. of thiamine, 14 mg. of niacin and 12 mg. of iron per 360 gm. of rice. The latter figure was the predicted daily per capita intake of rice. These surveys included clinical, biochemical and dietary examinations, but the clinical examinations were designed exclusively to detect certain evidences of beriberi, and the sample examined was heavily weighted with women, pregnant or lactating.

During the first clinical survey[11] in the experimental area (seven municipalities, population 63,359) the incidence of beriberi was given as 14.3 per cent. In the control area (two municipalities, population 6,098) the incidence was 6.66 per cent. In the second survey the incidence in the experimental areas was 1.54 per cent, a reduction of 12.76 per cent. In the control area the incidence was 8.69 per cent, an increase by 2.03 per cent. A total of 12,384 subjects were clinically examined in 1947 and 1948, and of these, 11,492 were reexamined in 1949 and 1950.

In the 1948 survey, samples of blood were obtained from 202 persons; 176 were young adult females (approximately one-third were pregnant and one-third were lactating), and 26 adult males. In 1950, blood samples were obtained from 200 persons; 172 were young adult females (about one-quarter were pregnant and one-half were lactating), and 28 adult males. Of the examinees in 1948, 127 were studied again in 1950. For analyses of thiamine, samples of urine were collected from forty persons in 1948 and from 44 in 1950. Samples were obtained from 39 subjects on both occasions. All persons examined biochemically were apparently taken only from the experimental area.*

The marked increases in hemoglobin levels and in serum and urinary thiamine levels in 1950 were obvious (see Table XX) and were attributed[14] to the effects of the rice enrich-

* Table XX compares the data obtained on the 127 persons who had blood drawn in both surveys and the 39 persons from whom urine specimens were obtained on both occasions.

TABLE
Dietary Survey Evaluation Sheet

Foodstuff	Remarks	Weight (gm.)	Total Calories	Protein (gm.)
Rice	Ordinary, white highly milled	380	1,370	25.5
Bread	Pan de Sal (buns) from wheat flour	20	70	3.8
Beans and legumes	Mongo (mungo bean) string beans	30	152	10.5
Root (starchy vegetable)	Mostly yellow sweet potatoes, a little cassava	25	31.2	0.35
Green, leafy vegetable	Sweet potato tops, kangkong leaves, malunggay leaves, in season	25	22.7	1.70
Other vegetables	Tomatoes, eggplant, bitter melon	40	18.8	0.44
Meat	Pork was used in the preparation of some vegetables	20	60	3
Fish	Protein was mostly from fish, such as dilis, alamang, hasahasa (small shrimps), etc.	150	189	77.9
Eggs	Both hens' and ducks' eggs were used	20	32	2.5
Oil or fat	Ordinary cooking fat	20	174	0.4
Milk and milk products	Evaporated milk used for coffee	15	20.85	1.05
Fruits	Fruits in season such as banana, papaya and guava	25	28.1	0.25
Sugar	Brown cane sugar	10	37.1	0
Total			2,205.65	127.39

* Figures were supplied by the Philippines Institute of Nutrition.

ment program. Burch and co-workers[14] concluded that serum protein and vitamin A levels were satisfactory in both surveys but that serum carotene and ascorbic acid levels were low. In the 1950 study urinary and serum riboflavin levels were also measured and judged to be relatively low.

Dietary surveys in Bataan were undertaken in 1948 and 1950 by the Institute of Nutrition, Manila, as part of the rice enrichment studies. The surveys were carried out by a questionnaire method and were confined to the 200 or so persons from whom samples of blood and urine were also obtained. Each participant recorded in domestic measure (cupful, slice, etc.) the foods consumed for three consecutive days. From these records the mean daily food intake per person was calculated. The tabulated results of each survey are shown in Tables V and VI which were taken from the FAO/WHO report.[12] As might be expected, the types and amounts of food consumed were remarkably similar in both surveys, except that the values for thiamine, niacin and iron were higher in the 1950 survey. The 1950 values were calculated by assuming that all the rice consumed was enriched. It should be pointed out, however, that analyses were not run to determine if this was in fact true. Whether the intake was actually increased is an unanswered question. The protein intake exceeded that recommended by the National Research Council and 60 per cent was reported to have been derived from animal sources. Calcium intake was low in both surveys.

The FAO/WHO nutrition survey in February and March 1952 was designed to examine persons suspected of having clinical beriberi. Of forty-seven adult persons presented to the team by local health officers as having beriberi, it was concluded that a mild form of the disease was undoubtedly present in forty-four.

A rapid dietary survey was carried out in the same group during March 1952. Each housewife was questioned as to the types of foods consumed on the day prior to the visit. The intake of rice per capita per day was estimated from the amount said to have been purchased over a stated period of time (weekly, biweekly, etc.), and the consumption of other items was determined, if possible, by weighing

V
before Rice Enrichment, 1948*

Fat (gm.)	Carbohydrate (gm.)	Calcium (mg.)	Phosphorus (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine (mg.)	Riboflavin (mg.)	Niacin (mg.)	Ascorbic Acid (mg.)
2.7	300	27	350	3.42	0	0.42	0.11	5.32	0
0.3	12.2	11	19	0.14	0	0.012	0.02	0.2	0
0.24	17.4	45.6	112	2.4	42.6	0.16	0.102	0.69	5.4
0.1	7.2	5.75	14.1	0.25	1,050	0.02	0.015	0.18	3.15
0.48	3.2	48.5	21.2	1.4	5,200	0.04	0.12	0.39	14.6
0.08	1.6	3.16	13.9	0.93	820	0.02	0.01	0.12	10.7
5	0.12	1.8	2.9	0.38	0	0.11	0.03	0.8	0
7.8	0.49	91.4	287	1.05	660	0.09	0.09	3.5	0
2.4	0.15	11	36	0.56	200	0.03	0.05	0.02	0
24	0	0	0	0.02	0	0	0	0	0
1.2	1.5	36	36	0.03	60	0.008	0.03	0.03	0.15
0.18	4.9	4.3	4.2	0.18	768	0.005	0.01	0.09	8.2
0	9.5	6.5	3	0.18	0	0	0	0	0
44.48	358.26	292.01	899.30	10.94	8,000.60	0.92	0.58	11.34	42.2

the quantity said to have been eaten at each meal. In this manner, 32 families in different towns or villages were studied comprising a total of 127 adults and 69 children twelve years of age or under. These families all belonged to the poorest section of the population.

The average daily intake per capita was calculated from food composition tables, and a typical calculation is recorded in Table VII. Rice was considered to be unenriched.

The intake of all nutrients recorded in this survey is appreciably lower than that recorded in the surveys conducted by the Institute of Nutrition (Tables V and VI). According to the standards set up by the ICNND, the diet has acceptable levels of thiamine and niacin, but is borderline both in calories and protein content, and the intake of iron is "low." The intake of calcium, vitamin A, riboflavin and ascorbic acid is definitely in the "deficient" category. If the values for enriched rice are used in the calculations, the thiamine content is increased from 0.674 to 2.112 mg., and iron intake from 7 to 13 mg. per day.

It is difficult to account for all the differences between the FAO/WHO survey and those of the Institute of Nutrition. The level of protein intake is a case in point. In both surveys, the intake of the main dietary protein sources (rice, fish and meat) was similar, yet the Institute of Nutrition recorded a daily intake of 130 gm. of protein whereas the FAO/WHO survey recorded only 48 gm. of protein. The latter group explains this by suggesting that the Institute of Nutrition, in their calculations, overestimated the protein content of the fish consumed. The most probable explanation for the discrepancies lies in the differences in technic, time of year of survey, and socioeconomic groups studied. The FAO/WHO group probably obtained a better estimate of intake by employing a weighing procedure. It is also obvious that they studied a poorer economic group than did the Institute of Nutrition. Furthermore, the FAO/WHO survey was carried out near the end of the dry season when vegetables were scarce and more expensive—hence, a lower intake of leafy and other vegetables and legumes was recorded. Comparison of the present study with the results of the previous surveys by the Institute of Nutrition and the FAO/WHO group may be helpful

TABLE
Dietary Survey Evaluation Sheet

Foodstuff	Remarks	Weight (gm.)	Total Calories	Protein (gm.)
Rice	Enriched rice	380	1,370	25.5
Bread	Pan de Sal (buns) from wheat flour	20	70	3.8
Beans and legumes	Mongo (mungo bean), string beans	40	172	12
Root (starchy vegetable)	Mostly yellow sweet potatoes, a little cassava	30	38	0.39
Green, leafy vegetable	Sweet potato tops, kangkong leaves, malunggay leaves, in season	30	10	1.4
Other vegetables	Tomatoes, egg plant, bitter melon	50	8	0.2
Meat	Pork was used in the preparation of some vegetables	20	60	3
Fish	Protein was mostly from fish, such as dilis, alamang, hasahasa (small shrimps), etc.	150	185	79.5
Eggs	Both hen's and duck's eggs were used	20	32	2.5
Oil or fat	Ordinary cooking fat	20	174	0.4
Milk and milk products	Evaporated milk used for coffee	15	20.85	1.05
Fruits	Fruits in season such as banana, papaya and guava	20	25	0.48
Sugar	Brown cane sugar	10	37	0
Total			2,201.85	130.22

* Figures were supplied by the Philippines Institute of Nutrition.

TABLE
Analysis of Average Diet (per Caput per Day) of

Foodstuff	Weight (gm.)	Total Calories	Crude Protein (gm.)	Fat (gm.)	Carbohydrate (gm.)
Rice, highly milled, raw (1)	436	1,570	29.2	3.0	344
Bread, white, wheaten (2)	17	60	3.2	0.2	11.1
Fish (3)	70	34	7	0.7	0
Shellfish (4)	61	18	3.3	0.1	0.3
Pork (5)	17	68	1.8	6.8	0
Leafy vegetables (6)	10	4	0.1	0	0.8
Root vegetables (7)	7	7	0.1	0	1.7
Other vegetables (8)	31	11	0.6	0.1	1.9
Eggs, hen	3	4	0.3	0.3	0
Fruit (9)	30	16	0.1	0.1	3.5
Cooking fat (10)	1.3	12	0	1.3	0
Sugar (11)	9	32	0.1	0	8.1
Total		1,836	46	13	371

NOTE: Quantities shown relate to weights as purchased. Nutrient values have been calculated on the edible in μg., 674; net thiamine in μg., 434 (after allowing for washing and cooking losses); net thiamine, non-fat calorie

in resolving some of these disagreements.

GENERAL ORGANIZATION

Upon arrival of the American group in Manila conferences were held with Philippine civilian and military personnel. The Armed Forces of the Philippines and the Philippine Institute of Nutrition agreed to provide facilities, personnel and other support, and the Joint U. S. Military Advisory Group agreed to furnish administrative assistance. The Health Division of the International Coopera-

VI
after Rice Enrichment, 1950*

Fat (gm.)	Carbohydrate (gm.)	Calcium (mg.)	Phosphorus (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine (mg.)	Riboflavin (mg.)	Niacin (mg.)	Ascorbic Acid (mg.)
2.7	300	27	350	15.8	0	1.7	0.11	17	0
0.3	12.2	11	19	0.14	0	0.012	0.02	0.2	0
0.32	25	40.1	163.8	2.9	40	0.35	0.05	1	6
0.12	7.7	9.2	16.5	0.3	1,260	0.03	0.02	0.21	3.8
0.07	1.1	75	32	1.03	6,000	0.02	0.04	0.32	19
0.05	1.7	14.3	10.4	0.95	259	0.02	0.02	0.35	10.4
5	0.12	1.8	2.9	0.38	0	0.15	0.03	0.8	0
3.1	1.2	68	182	1.4	390	0.09	0.05	3	0
2.4	0.15	11	36	0.56	200	0.03	0.05	0.02	0
24	0	0	0	0.02	0	0	0	0	0
1.2	1.5	36	36	0.03	60	0.008	0.03	0.03	0.15
0.2	8	6	12	0.56	59	0.004	0.008	0.16	6.6
0	9.5	6.5	3	0.18	0	0	0	0	0
39.46	368.17	305.9	863.6	24.25	8,268.0	2.42	0.43	23.09	45.95

VII
Thirty-Two Households in Bataan Province, March 1952

Calcium (mg.)	Phosphorus (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine (μg.)	Riboflavin (μg.)	Niacin (mg.)	Ascorbic Acid (mg.)
30.5	401.1	3.9	0	480	131	6.1	0
9.3	16.3	0.1	0	10	19	0.2	0
12.9	79.8	0.4	0	41	39	1.8	0
11.9	39.7	0.3	13	23	11	0.5	0
1.1	19.2	0.3	0	60	22	0.5	0
2.6	4.6	0.1	620	13	30	0.2	0.77
1.4	3.3	0.1	252	6	4	Trace	0.76
13.8	18.8	0.3	318	32	12	0.3	3.15
1.5	4.9	0.1	27	4	9	0	0
3.7	3.3	0.3	225	5	7	0.1	3.25
0	0	0	0	0	0	0	0
7.2	3.6	1	0	0	0	0	0
96	595	7	1,455	674	284	9.7	7.93

portion, using the percentage for edible portion as recorded in tables. Non-fat calories: 1,719. Gross thiamine ratio, 0.25.

tion Administration Mission to the Philippines (ICA) provided invaluable aid in organizing and assembling background for the work. The survey team consisted of seven Americans, five Philippine army officers, twenty enlisted men and twelve civilians. Nine of the latter were from the Philippine Institute of Nutrition and three from the University of the Philippines. (A complete list of the personnel appears in the acknowledgment section at the end of this paper.)

After the survey plan was approved, the

TABLE VIII

Percentage Distribution of Individuals Examined by Area of Origin and Branch of Service
(Detailed Examinations Only)

Branch of Service	No. of Men	Rural	Urban	Location*				
				B	C	D	E	F
Army	727	39.1	60.9	17	60.4	20	2.3	0.3
Constabulary	340	22.6	77.4	4.1	22.6	51.8	21.2	0.3
Air Force	131	39.7	60.3	10.7	38.9	43.5	6.9	0
Navy	135	41.5	58.5	14.1	53.3	29.6	3	0
Total survey	1,333	35.2	64.8	12.8	47.9	31.4	7.7	0.2

* Location code in this and following tables: B = Northern Luzon; C = Southern Luzon; D = Visayan; E = Mindanao and the Sulu Archipelago; F = Palawan.

Surgeon General's Office sent directives to the units setting forth the detailed requirements for the work. The headquarters of the survey was established at the Philippine Institute of Nutrition in Manila, where the biochemical laboratory was installed. Arrangements were made with the Philippine Airlines for shipment of blood, urinary and stool specimens from the various field points to Manila.

All cooperating personnel were instructed in the general survey approach and in specific procedures to be employed. Initially the clinicians devoted considerable time and effort to standardizing their criteria for the diagnosis of clinical lesions employing descriptions, photographs and a practice period of examinations.

Arrangements for parasitologic studies were made with Dr. Mariano Yogore and Dr. Benjamin Cabrera of the Institute of Hygiene of the University of the Philippines. Dr. Solita Camara-Besa and her collaborators in the Biochemistry Department of the College of Medicine, University of the Philippines, requested permission to measure serum cholesterol levels in the subjects selected for examination. The results of these studies were compiled independently for publication separately.[27,28]

THE SAMPLING PROCEDURE

Selection of Units

The Armed Forces of the Philippines consists of four branches, Army, Constabulary, Air Force and Navy. The Army is the largest branch. For purposes of this study, the Army and Constabulary outside of Manila were divided into four areas. These are (1) Luzon, north of Manila, (2) Luzon, south of Manila, (3) the Visayan Islands and (4) Mindanao and the Sulu Archipelago. In so far as possible, Army Battalion Combat Teams were selected at random in these various areas. Time and transportation limited the selection of Constabulary units to those within the vicinity of the Army Battalion Combat Teams included in the sample. In areas where Battalion Combat Teams were not operating, however, Constabulary units that were readily accessible by air were selected for examination. In addition, an attempt was made to attain a reasonable geographic coverage of the islands to the south of Luzon.

Men from two major Air Force bases were examined and a small detachment from an auxiliary airport was seen. Selection of units was made to give a representative cross section of the enlisted personnel of the Air Force.

The sample of Navy personnel included units from a major Naval base and a ship from a task force based in the southern islands. Both ship and shore-based personnel were examined.

There was some difference between the original sampling plans and those actually carried out. Deviation from the original plan was necessitated by movement of troops during the survey, unexpected transportation difficulties, curtailment of military transportation due to the tragic death of President Magsaysay, and other considerations. It is believed, however,

that an informative sample (a reasonably representative cross section) of the Filipino military was obtained.

Selection of Persons from Chosen Units

Only enlisted men were examined. At the larger bases surrounding Manila, where the men engaged in a variety of activities, men were selected on a quota basis from within various activity categories. For example, a request was given the Base Commander for a specified number of men from each of the types of activity represented on the base. The service occupation was used to define the men's activity. No measurements of metabolism or energy expenditure were made, so the activity classifications are but gross qualitative indications of the amount of energy the men expended each day.

In outlying areas there were frequently insufficient men in the smaller units to occupy the survey team for more than part of a day. In such situations all available enlisted men were examined. In many field units, troops were widely deployed and were not available for examination. Under these conditions a greater proportion of the headquarters than field troops were available for examination, but attempts were made to sample the latter group more heavily. The policy of frequent rotation of combat troops allowed study of men who had but recently returned to headquarters and thereby aided in obtaining a more representative picture of the troops.

The ratio of detailed to abbreviated clinical examinations varied with the size of the group being examined, but in every case the choice of those subjects who were to receive a detailed examination was random and made at the beginning of each day. Where there were large groups of men, one of each five examinees was given a detailed examination. Where the groups were smaller, this proportion was increased. In a few small groups all the men received a detailed examination. A similar selection procedure was used for the biochemical examinations, which were performed only on those persons who had received a detailed clinical examination. In the larger groups one in five of those given the detailed

TABLE IX
Number of Individuals Studied in Philippine Armed Forces by Branch of Service and Location

Location Code	Unit		No. of Examinations		
			Detailed	Abbreviated	Biochemical
	Army				
A	Trainees	1	92	372	17
	Headquarters troops	2	86	361	18
	Medical	3	49	202	9
	Signal	4	48	74	15
B	Battalion combat teams	1	55	142	13
		2	30	44	10
		3	68	110	19
		4	26	0	13
		5	44	45	22
		6	50	176	9
C	Battalion combat teams	1	20	43	9
		2	46	138	14
			34		
D	Headquarters troops	1		141	9
E	Battalion combat teams	1	79	83	25
Total			727	1,931	202
	Constabulary				
A	Trainees	1	24	106	4
	Headquarters troops	2	22	75	6
B	Company	1	14	29	4
		2	18	0	6
C	Company	1	9	0	5
D	Company	1	18	0	4
		2	41	0	14
		3	31	0	11
		4	25	25	13
E	Company	1	27	0	2
		2	36	0	14
		3	51	0	17
		4	24	0	9
Total			340	235	109
	Air Force				
A	Company	1	42	174	8
B	Company	1	55	131	11
E	Detachment	1	34	0	11
Total			131	305	30
	Navy				
A	Ship		103	257	21
E	Shore		32	173	6
Total			135	430	27
Total survey			1,333	2,901	368

TABLE X

Percentage Distributions, Age of Individuals Studied by Branch of Service
(All Clinical Examinations, Detailed and Abbreviated)

Branch of Service	No. of Men	18–19 yr.	20–24 yr.	25–29 yr.	30–34 yr.	35–39 yr.	40+ yr.
Army	2,658	0.3	24.2	35.7	21.3	12.4	6.1
Constabulary	575	1.9	17.2	24.2	20.5	23	13.2
Air Force	436	1.8	17	43.4	26.4	9.4	1.8
Navy	565	3	37.8	41.5	13.7	3.4	0.7
Total survey	4,234	1.1	24.3	35.7	20.7	12.3	5.9

TABLE XI

Percentage Distributions, Length of Service of Individuals Studied by Branch of Service
(All Clinical Examinations, Detailed and Abbreviated)

Branch of Service	No. of Men	Length of Service					
		<3 mo.	3 mo.–2 yr.	2–5 yr.	5–10 yr.	10–15 yr.	15+ yr.
Army	2,658	18.2	0.4	8.1	48.7	12.2	12.4
Constabulary	575	22.8	0	3.5	24.5	17.6	31.7
Air Force	436	1.4	7.3	22.2	48.9	10.8	9.4
Navy	565	0.5	29.2	32.7	27.1	9.9	0.5
Total survey	4,234	14.7	4.9	12.2	42.5	12.5	13.1

TABLE XII

Height, Weight and Per Cent Standard Weight by Age, Detailed (D) and Abbreviated (A) Examinations

Data	18–24 yr.		25–29 yr.		30–34 yr.		35–44 yr.		45+ yr.		Total	
	D (260)*	A (813)	D (480)	A (1,029)	D (290)	A (585)	D (266)	A (436)	D (36)	A (34)	D (1,333)	A (2,901)
Mean height (in.)	64.2	64.2	64	64	63.8	63.9	64	63.7	63.9	64	64	64
Mean weight (lb.)	119.5	117.2	122.4	120.9	124.4	123.3	130.6	126.1	135.1	133.6	124.2	121.3
Mean (%) standard weight	91.4	89.8	91.5	90.3	91.9	90.8	93.4	91.2	94.2	93.7	92	90.4

* In this and subsequent tables figures in parentheses represent number of persons examined.

clinical examination (hence, one in twenty-five of total examinees) was randomly selected for biochemical tests. In smaller units this proportion was increased up to every other man given a detailed clinical examination. In five locations men who ate away from the mess were selected for diet interviews. All those chosen had received biochemical examinations. The first man of every five who thus qualified was subjected to the diet interview.

The final sample selected is described fully in terms of numbers, locations, branch of service, age, length of service and area of troop origin in Tables VIII through XI.

CLINICAL FINDINGS

Two types of clinical examinations were made, a detailed examination including sixty-two items of possible nutritional significance, and an abbreviated examination including sixteen of the foregoing items.

The general appearance of 85 per cent of the men examined was considered to be good. The data on height, weight and age are presented in Table XII. The average height was

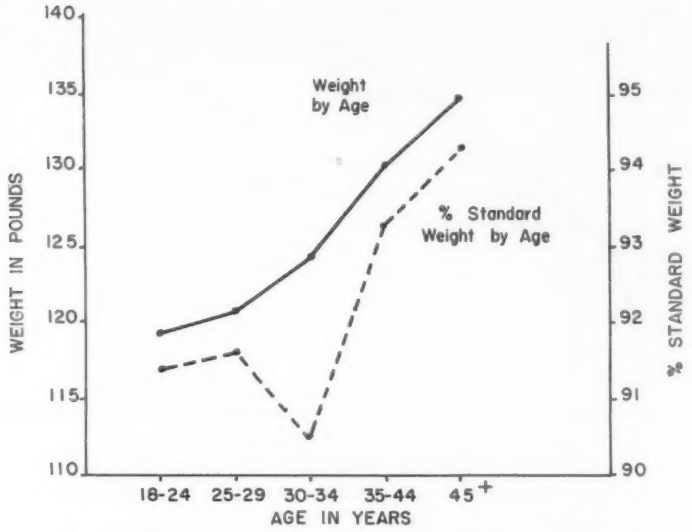

FIG. 1. Changes in weight and per cent standard weight by age.

64.0 inches and weight 122.2 pounds. The average percentage of the American Medico-Actuarial standard weight was 92 (Table XII). Changes in weight and in per cent standard weight with age are shown in Figure 1. The lower level of standard weight found for the 21 per cent of men in the thirty to thirty-four year age group is obviously in part responsible for the lower than expected average per cent of standard weight of the total sample.

The median skinfold thicknesses for the arm and scapula sites were 5.7 and 10.4 mm., respectively (arithmetic means were 6.7 and 12.1 mm.). Both measurements increased slightly with age (Fig. 2) and more significantly with increasing per cent of standard weight (Table XIII).

TABLE XIII
Skinfold Thickness by Per Cent Standard Weight

Skinfold Measured	Per Cent Standard Weight					
	<80 (120)	80–89.9 (503)	90–99.9 (446)	100–109.9 (191)	≥110 (65)	Total (1,333)
Median skin thickness:						
Arm (mm.)	4.1	4.6	6.3	9.4	12.9	5.7
Scapula (mm.)	8	9	11.3	16.9	21.5	10.4

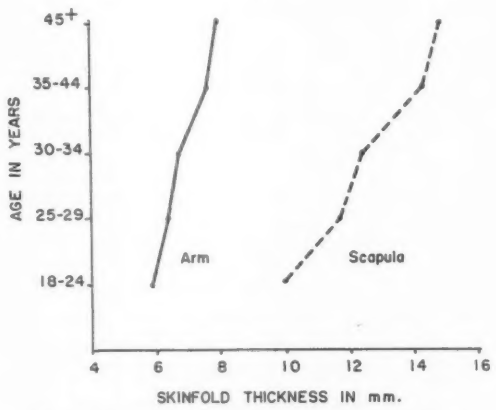

FIG. 2A. Skinfold thickness in relation to age.

A history of malaria was given by 37 per cent of the men examined. It was most common in those originating from the Sulu Archipelago and Mindanao, where 55 per cent of examinees reported a past history of this disease. The per cent of men with a history of malaria increased with age (Table XIV) and time in service (Table XV), and was greatest among men less than 80 per cent of standard weight. A history of recent diarrhea was noted in 1.2 per cent of the men.

Enlargement of the thyroid occurred in an average incidence of 2.8 per cent. It was ob-

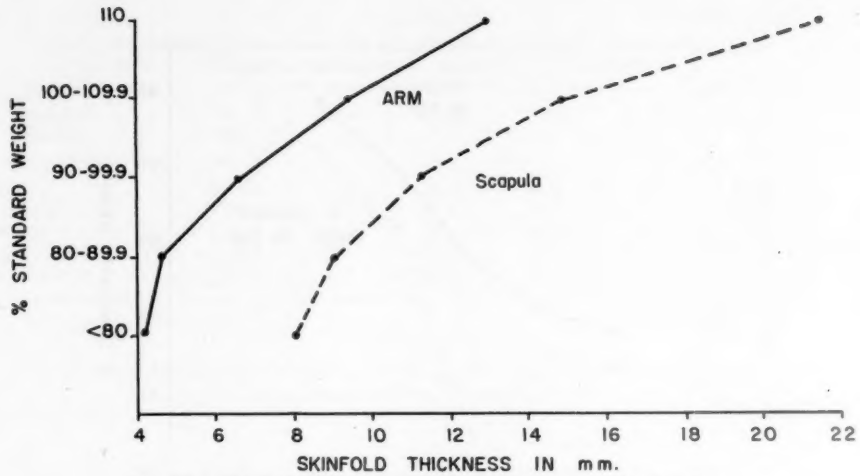

FIG. 2B. Skinfold thickness in relation to per cent standard weight.

served in 4.1 per cent of men coming from northern Luzon, which includes the goiter belt of the Philippines. The main goiter region in the Philippines[15] is the Province of Nueva Ecija in the central valley of Luzon, particularly the twin municipalities of Penaranda and Papaya. Other goiter centers in Luzon are: Abra Province in the northwest, Bontoc, Isabela Province on the east, the Bataan peninsula, and Tayabas and Batangas in southern Luzon. Goiter has also been identified on Panay, Negros and Cebu in the central part of the Philippine Archipelago, and on Mindanao in the south.[16]

TABLE XIV

Relation of Age to Per Cent Incidence of Selected Clinical Signs

Clinical Signs	18–24 yr.		25–29 yr.		30–34 yr.		35–44 yr.		45+ yr.	
	D (260)	A (813)	D (480)	A (1,029)	D (290)	A (585)	D (266)	A (436)	D (36)	A (34)
Malaria	20	...	32.5	...	42.1	...	54.5	...	50	...
General appearance:										
Good	87.3	...	88.1	...	82.8	...	80.8	...	72.2	...
Fair	11.9	...	11.5	...	17.2	...	19.2	...	27.8	...
Enlarged parotid	2.7	...	6	...	10	...	21.8	...	25.5	...
Thickened conjunctivae	71.9	...	85	...	87.6	...	88.3	...	80.6	...
Pingueculae	53.1	...	84.2	...	90.3	...	91.7	..	94.4	...
Papillary hypertrophy, moderate to severe	11.5	...	10.8	...	11	...	7.1	...	0	...
Gum marginal redness	8.5	...	5.8	...	9.3	...	10.5	...	19.4	...
Gum marginal swelling	5	...	5	...	6.9	...	12.8	...	16.7	...
Follicular keratosis	4.6	4.1	3.8	3.2	4.1	2.6	1.9	2.3	0	0
Scrotal dermatitis	3.5	1.7	0.8	0.6	1	0.3	1.5	0.2	0	0
Thickened pressure points	6.5	...	8.1	...	12.1	...	15.0	...	16.7	...
Blood pressure:										
140/90 mm. Hg	1.9	...	5	...	9	...	16.2	...	44.4	...
150/100 mm. Hg	0	...	0.4	...	1	...	3.8	...	8.3	...
Bilateral edema	0	0.1	0.2	0	0	0	0	0	2.8	0
Loss of ankle jerk	1.9	3.6	2.1	1.1	2.1	1.9	4.9	3.7	5.6	6

TABLE XV
Per Cent Incidence of Selected Clinical Signs by Time in Service

Clinical Signs	Time in Service					
	<3 mo. (124)	3 mo.–4 yr. (182)	5–9 yr. (603)	10–14 yr. (184)	15+ yr. (239)	Total (1,333)
Malaria	14.3	17	36.3	47.3	57.7	36.9
Enlarged thyroid	2.4	3.8	2.7	2.7	2.5	2.8
Enlarged parotid	1.6	3.8	6.8	15.2	22.6	9.9
Nasolabial seborrhea	24.2	30.2	32.3	26.1	28.5	29.7
Pigmentation	0.8	1.1	2.5	3.3	3.3	2.4
Thickened conjunctiva	60.5	83.5	85.7	87.2	87.4	83.6
Pingueculae	39.5	72.5	85.6	90.2	92.1	81.2
Conjunctival injection	50	59.9	50	52.7	60.7	53.9
Cheilosis	5.6	0.5	2	3.3	2.5	2.4
Filiform papillary atrophy*	2.4	4.9	3	4.3	4.6	3.7
Pappillary hypertrophy*	16.1	7.1	10.3	12.5	6.3	10
Red tip and/or lateral margin	7.3	11.5	10.4	13	10	10.6
Marginal redness	12.9	1.1	7.6	9.8	13	8.5
Marginal swelling	6.5	2.7	5.6	8.7	14.2	7.3
Bleeding or scorbutic gums	2.4	0.5	0	0	0	0.3
Caries	49.6	35.1	36	36.4	37.2	..
Follicular keratosis	5.6	3.8	3.5	4.3	1.8	3.5
Scrotal dermatitis	6.5	0	1	1.1	1.8	1.5
Thickened pressure points	5.6	7.1	8.1	18.5	14.6	10.4
Loss of ankle jerk	1.6	2.1	2	2.2	4.6	2.4

* Moderate to severe. (Over 2.4 per cent total incidence and omitted: general appearance, other seborrhea.)

TABLE XVI
Relation of Selected Clinical Signs to Per Cent Standard Weight
(Detailed Examinations)

Clinical Signs	Per Cent Standard Weight				
	<80.0 (120)	80–89.9 (503)	90–99.9 (446)	100–109.9 (191)	110 (65)
	Per Cent Occurrence				
General appearance:					
Good	42.5	81.9	95.1	92.7	93.8
Fair	55.8	17.9	4.9	7.3	6.2
Poor	1.7	0.2	0	0	0
Enlarged parotid	2.5	5	9	17.3	46.2
Seborrhea other than nasolabial	9.2	5.8	4.4	3.1	3.1
No caries	75	38.2	37.9	37.7	33.8
Thickened pressure points	15	8	8.7	14.1	20
Hepatomegalia	0.8	0.6	1.6	2.1	4.6
Loss of ankle jerk	0.8	1.8	2.9	2.1	6.2

The parotid glands were enlarged in 9.9 per cent of all men examined. The incidence was higher in men from the Visayan Islands and Mindanao—56 per cent in examinees in Tacloban. The incidence of parotid enlargement was positively correlated with increasing per cent standard weight (Table XVI), age (Table XIV) and time in service. The correlation with per cent standard weight is opposite to that reported by Sandstead and co-workers[17] who observed a negative correlation with per cent standard weight, but is similar to that found

TABLE XVII
Per Cent Incidence of Selected Clinical Signs* by Branch of Service
(Detailed Examinations)

Clinical Signs	Army	Constabulary	Air Force	Navy	Total
Current diseases:					
Suspect malaria	37.6	47.6	26	17.8	37
Glands:					
Thyroid enlargement	3.2	1.2	5.3	2.2	2.8
Parotid enlargement	7.7	19.1	5.3	3	9.9
Skin, face and neck:					
Nasolabial seborrhea	32.2	30.9	24.4	19.3	29.8
Skin, general:					
Follicular keratosis	3.2	2.9	5.3	5.2	3.5
Thickened pressure points	8.3	17.1	12.2	3	10.4
Eyes:					
Thickened conjunctivae	82.8	83.8	87	83.7	83.6
Conjunctival injection	49	64.7	44.3	62.2	53.9
Lips:					
Angular scars	68.5	64.1	71.0	85.9	69.2
Cheilosis	3.7	1.2	0.8	0	2.4
Tongue:					
Filiform papillary atrophy†	3.3	4.7	1.5	5.2	3.7
Papillary hypertrophy†	11.3	10.6	5.3	5.9	10
Serrations and swellings	19	16.8	16	20	18.2
Red tip or lateral margins	8.8	10.9	11.5	18.5	10.6
Gums:					
Red or swollen	11.4	17.6	5.3	3	11.6
Teeth:					
Caries (1–5+)	61.8	64.4	61.9	58.5	62.1
Lower extremities:					
Loss of ankle jerk (bilateral)	2.3	3.2	1.5	1.5	2.4

* The following signs had an incidence of over 2.4 per cent, but were omitted as being less informative nutritionally: general appearance, other seborrhea, face and neck pigmentation, pingueculae, blepharitis, furrows (tongue), slight filiform papillary atrophy, slight papillary hypertrophy, malposition (teeth) and worn teeth.
† Moderate to severe.

among the Navajo.[18] Although this sign has been repeatedly recorded in populations subsisting on chronically inadequate diets, its nutritional significance is not known.

Thickening of the conjunctiva was an extremely common finding, and was noted in 83.6 per cent of the men examined (Table XVII). The incidence of this lesion increased with age (Table XIV) and time in service (Table XV). Pingueculae were also present in 31.2 per cent of all the men examined, although the Navy personnel revealed a lower incidence. Pingueculae were correlated with both age and time in service. Conjunctival injection was frequently encountered, its presence being correlated with age. A Bitot's spot was found in only one man of the 1,333 detailed examinees (Table XVIII).

The over-all incidence of follicular keratosis was 3.5 per cent. This finding was more common in men under thirty-five years of age (Table XIV), and in those below 110 per cent of standard weight. Scrotal dermatitis was encountered in only 1.5 per cent of the total sample, although it was present in 6.5 per cent of men in service less than three months (Table XV). The dermatitis was not severe and was rarely more than a small patch along the median raphe of the scrotum. The total incidence of thickened pressure points was 10.4 per cent, with considerable examiner difference (5.7 versus 17.2 per cent). The usual lesion was thickening or pigmentation along the ulna just below the elbow. In a few men it was over the great trochanters of the femurs. These lesions were correlated with location, age and time in service (Tables XIV and XV).

Bilateral loss of ankle jerk was noted in

TABLE XVIII
Clinical Findings* in Philippine Armed Forces, 1957
(Detailed Examinations)

Physical Findings	No. Examined	Per Cent
Current diarrhea	16	1.2
Suspected trachoma	7	0.5
Suspected tuberculosis	8	0.6
General appearance:		
Poor	3	0.2
Glands:		
Enlarged submaxillary	7	0.5
Skin, face and neck:		
Erythema	3	0.2
Skin, general:		
Xerosis	7	0.5
Acneform eruption	30	2.3
Scrotal dermatitis	20	1.5
Hyperpigmentation	3	0.2
Pellagrous lesions	1	0.1
Eyes:		
Bitot's spots	1	0.1
Circumcorneal injection	5	0.4
Lips:		
Angular lesions	12	0.9
Tongue:		
Fungiform papillary atrophy	8	0.6
Fissures, erosions or ulcers	30	2.3
Glossitis	11	0.8
Magenta color	7	0.5
Geographic	19	1.4
Gums:		
Atrophy of papillae	3	0.2
Recession of papillae	19	1.4
Bleeding gums	3	0.2
Scorbutic-type	1	0.1
Teeth:		
Edentulous	16	1.2
Abdomen:		
Hepatomegalia	19	1.4
Splenomegalia	11	0.8
Lower extremity:		
Loss of ankle jerk, unilateral	13	1
Loss of knee jerk	23	1.7

* For items in total sample with a frequency of less than 2.4 per cent.

TABLE XIX
Distribution of Selected Clinical Findings by Examiner
(Detailed Examinations)

Clinical Signs	Per Cent Observations by Examiner	
	Examiner A (784)	Examiner B (535)
Thyroid enlarged	2.7	3
Nasolabial seborrhea	24.1	38.3
Filiform papillary atrophy, moderate to severe	4	3.2
Loss of ankle jerk	1.9	3
Lips:		
Angular lesions	0.3	1.9
Angular scars	90.3	39.3
Cheilosis	0.5	5.2

2.4 per cent of the total sample. This finding increased with age (Table XVI), and in men from northern Mindanao (13.7 per cent of examinees). The knee jerk was tested only in men who had lost the ankle jerk. Bilateral loss of the knee jerk was recorded in 1.7 per cent of the total sample (Table XVIII). These neurologic aberrations were more frequent than has been encountered among other such groups examined.

Nasolabial seborrhea was seen in 29.8 per cent and other seborrhea in 5.4 per cent of the subjects examined in detail. The apparent differences in incidence of seborrhea in the various tabulations in part reflect differences between examiners in the recording of this lesion (Table XIX). Facial pigmentation was noted in 2.4 per cent of the men, and appeared to be correlated with time in service (Table XV), and also slightly with age.

Scars at the angles of the mouth were commonly noted. Although the exact incidence of this lesion cannot be stated because of differences in diagnostic criteria of the two examiners (Table XIX), it is noteworthy that the examiner recording the lower incidence noted 39.3 per cent. Active angular fissuring was noted in but 0.9 per cent and cheilosis was observed in 2.4 per cent of the total sample. Cheilosis was higher among recent inductees (5.6 per cent), (Table XIX). There was also appreciable difference in the frequency of the recording of this lesion by the several examiners.

Atrophy of the filiform papillae of the tongue of moderate or severe degree was noted in 3.7 per cent of the men (Table XV). The atrophy was almost all localized. Papillary hypertrophy and hyperemia, primarily of the fungiform papillae, and involving one-third or

TABLE XX
Biochemical Findings of Nutrition Surveys in the Philippines
(Means)

	1948[12]	1950[12]	1957
Composition of Sample			
Women			
Pregnant	Approx. 33%	Approx. 25%	....
Lactating	Approx. 33%	Approx. 50%	....
Men	Approx. 12–15%	Approx. 15%	100% (366)
Biochemical Findings			
Hemoglobin (gm./100 ml.)	10.9 ± 0.24	12.9 ± 0.18	14.70 ± 0.08
Serum protein (gm./100 ml.)	6.7 ± 0.05	6.8 ± 0.06	6.50 ± 0.03
Serum vitamin A (μg./100 ml.)	42.3 ± 1.1	35.0 ± 1.4	49.3 ± 0.7
Serum carotene (μg./100 ml.)	48.4 ± 2.6	74.0 ± 4.4	72.6 ± 1.8
Serum ascorbic acid (mg./100 ml.)	0.49 ± 0.03	0.48 ± 0.03	0.46 ± 0.02
Urinary thiamine (μg./gm. creatinine)	65 ± 13	253 ± 49	89*

* Median value.

more of the tongue were recorded in 10 per cent, most reports having been made by one examiner (I. P.). Reddened tip and lateral margins were noted in 10.6 per cent, with a higher reporting rate by one examiner (W. U.). This may reflect differing classification of the same lesion, since hypertrophic hyperemic papillae were commonly observed on the tip and margins of the tongue. Glossitis was uncommon; its incidence was 0.8 per cent for all men examined (Table XVIII), but an incidence of 2.9 per cent was found in men from Mindanao. Magenta tongue was seen in only 0.5 per cent of the men examined.

Marginal redness and swelling of the gums were noted in 11.6 per cent of the detailed sample. One examiner (I. P.) recorded more of each of these gingival lesions than did the other. Bleeding and scorbutic-type gums were observed in 0.2 per cent of the total sample. The highest group incidence was 2.4 per cent among men in service less than three months (Table XV).

Some evidence of active dental caries was recorded in 65.7 per cent of the detailed sample. The extent of caries was usually minimal. The prevalence of observed dental disease was highest among troops under twenty-five years of age and under 80 per cent of standard weight, and lowest among those with less than three months of service and those who came from northern Luzon. Edentia was uncommon (1.2 per cent, Table XVIII). It increased with advancing age and time in service. Worn occlusal surfaces of the teeth were recorded in 20.4 per cent and malposition in 11.9 per cent of the detailed sample. The former increased with age and time in service, and was highest among troops originating from northern Luzon.

The blood pressure was above 140/90 mm. Hg in 8.3 per cent and above 150/100 in 1.4 per cent of the men examined. The mean systolic and diastolic blood pressure levels were higher with advancing age (Table XIV), time in service and increasing body weight and skinfold thickness.

Enlargement of the liver was recorded by only one examiner (in 1.4 per cent of the detailed sample). Splenomegaly was noted in 0.8 per cent of the subjects examined (Table XVIII).

BIOCHEMICAL EXAMINATIONS

Methods

A sample of venous blood was drawn from each man selected for biochemical study, and he was given a plastic bottle into which to collect a random urine sample and a cardboard container for a stool specimen. The creatinine

TABLE XXI
Summary of Blood Analyses by Branch of Service

Blood Analysis		Army	Constabulary	Air Force	Navy	Total
Hemoglobin (gm./100 ml.)	No.	202	108	30	27	366
	Mean	14.57	15.19	14.38	14.03	14.7
	S.D.	1.42	1.43	1.45	1.42	1.47
	S.E.	±0.10	±0.14	±0.26	±0.27	±0.08
% Distribution	<12.0	1.5	0.9	0	0	1.1
	12.0–13.9	32.7	17.6	46.7	48.1	30.6
	14.0–14.9	31.7	25.9	30	29.6	29.8
	≥15.0	34.1	55.6	23.3	22.2	38.5
Plasma protein (gm./100 m.l)	No.	202	107	30	27	366
	Mean	6.59	6.47	6.23	6.41	6.50
	S.D.	0.625	0.479	0.481	0.473	0.572
	S.E.	±0.04	±0.05	±0.09	±0.1	±0.03
% Distribution	<6.0	9.9	11.2	13.3	3.7	10.1
	6.0–6.3	39.1	38.3	63.3	70.4	43.2
	6.4–7.1	39.1	44.9	23.3	22.2	38.3
	≥7.2	11.9	5.6	0	3.7	8.5
Vitamin A (μg./100 ml.)	No.	199	109	30	27	365
	Mean	49.1	51.7	45.2	46.8	49.3
	S.D.	13.9	12.3	12.0	12.0	13.2
	S.E.	±1	±1.2	±2.2	±2.3	±0.7
% Distribution	<10	0	0	0	0	0
	10–19	0	0	3.3	0	1.1
	20–49	56.3	41.3	50	59.3	68.2
	≥50	43.7	58.7	46.7	40.7	30.7
Carotene (μg /100 ml.)	No.	199	109	30	27	365
	Mean	74.6	58.4	91.2	93.4	72.6
	S.D.	31.2	28.1	28.6	49.2	33.5
	S.E.	±2 2	±2.7	±5.2	±9.5	±1.8
% Distribution	<20	0.5	2.8	0	0	1.1
	20–39	7.5	22.9	3.3	0	11.2
	40–99	71.4	65.1	56.7	66.7	67.9
	≥100	20.6	9.2	40	33 3	19.7
Vitamin C (mg./100 ml.)	No.	198	109	30	26	363
	Mean	0 46	0.51	0.26	0.53	0.46
	S.D.	0.299	0.3	0.266	0.285	0.299
	S.E.	±0.02	±0.03	±0.05	±0.06	±0.02
% Distribution	<0.10	6.6	2.8	33.3	0	7.2
	0.10–0.19	10.1	9.2	20	0	9.9
	0.20–0.39	30.3	33.9	26.7	42 3	32
	≥0.40	53	54.1	20	57.7	51

content of the urine samples was determined and the results of urinalysis are expressed per gram of creatinine, rather than on a time basis.

Blood samples were placed in 7 ml. oxalated (20 mg. potassium oxalate per tube) and 20 ml. (no anticoagulant added) vacutainers.

TABLE XXII
Summary of Urinalyses by Branch of Service

Urinalysis		Army	Constabulary	Air Force	Navy	Total
Thiamine (μg./gm. creatinine)	No.	188	105	29	24	346
	Median	101	63	86	104	89
% Distribution	<27	13.8	16.2	6.9	8.3	13.5
	27–65	22.3	37.1	34.5	16.7	27.5
	66–129	25.5	19	27.6	41.7	24.9
	÷130	38.3	27.6	31	33.3	34.1
Riboflavin (μg./gm. creatinine)	No.	188	103	29	24	344
	Median	154	183	149	130	158
% Distribution	<27	0.5	3.9	3.5	4.2	2
	27–79	6.4	1.9	3.5	0	4.4
	80–269	83.5	74.8	82.7	83.3	80.8
	≥270	9.6	19.4	10.3	12.5	12.8
N′-methylnicotinamide (mg./gm. creatinine)	No.	180	102	29	24	335
	Median	4.8	5.1	3.9	4.3	4.8
% Distribution	<0.50	0	1.0	3.5	0	0.6
	0.50–1.59	3.9	7.9	10.3	0	5.4
	1.60–4.29	38.3	29.4	41.4	50	36.7
	≥4.30	57.8	61.7	44.8	50	57.3

The oxalated sample was used in the field for determination of serum protein and hemoglobin by the specific gravity method. Day-to-day fluctuations of electrical current in the field rendered data on hematocrits unreliable, so these determinations were abandoned early in the survey and no data are presented.

The vacutainers containing ±15 ml. of whole clotted blood, the containers with 50 ml. aliquots of urine (to which 1.0 ml. of acetic acid was added as preservative), and the stool specimens were packed with ice in an insulated can and transported to the laboratory of the Institute of Nutrition in Manila, where the vitamin analyses were performed. Transportation arrangements were such that the samples usually arrived in Manila on the same day that they were obtained, and in no case later than the next morning. All samples arrived in good condition and with sufficient ice to insure safe transit.

The laboratory procedures used were those detailed in the ICNND Manual.[19] Briefly they are as follows.

As already indicated, hemoglobin and serum protein determinations were carried out where the samples were taken, using the copper sulfate specific gravity method.[20–22] Vitamin C in serum was measured by the dye method, based on the extent to which the dye 2,6-dichlorobenzenone indophenol is decolorized in the presence of ascorbic acid.[23] Serum vitamin A and carotene were determined by the Carr-Price reaction.[24] Thiamine was determined by the thiochrome method, modified from that described by Consolazio, Johnson and Marek.[25] Riboflavin was determined fluorometrically by the procedure described by the same workers.[25] The low riboflavin content of the urine made it advisable to use 2 ml. of urine rather than 1 for riboflavin assays. Niacin was measured in terms of presence of its metabolite N′-methylnicotinamide. The method used is that of Huff, Perlzweig and Tilden,[26] with the exception that all urine specimens so analyzed were decolorized with charcoal before assay. Creatinine was estimated using the alkaline-picrate reaction of Folin and Wu.[27]

TABLE XXIII

Blood and Urine Analyses by Location

Location Code	Unit	No. of Samples	Hemoglobin (gm./100 ml.) Mean	Plasma Protein (gm./100 ml.) Mean	Vitamin A (μg./100 ml.) Mean	Carotene (μg./100 ml.) Mean	Vitamin C (mg./100 ml.) Mean	Thiamine (μg./gm. creatinine) Median	Riboflavin (μg./gm. creatinine) Median	N'-methylnicotinamide (mg./gm. creatinine) Median
	Army									
A	Trainees	14–17	13.29	7.05	41.6	50.9	0.22	214	111	6.4
	Headquarters troops	14–18	14.84	6.99	41.2	75.6	0.31	142	142	4.8
	Medical	9	13.31	6.5	48.7	102.3	0.68	142	153	4.8
	Signal	11–15	14.77	6.79	40	79.2	0.63	77	138	3.8
B	Battalion combat teams 1	10–13	13.93	5.95	43.9	90.6	0.28	83	124	7.4
	Battalion combat teams 2	10	14.35	6.11	49	78.5	0.22	200	142	7.9
	Battalion combat teams 3	18–19	15.7	6.22	46.7	82.9	0.39	165	194	6
	Battalion combat teams 4	12–13	14.08	5.78	41.2	90.6	0.17	41	165	6.1
	Battalion combat teams 5	20–22	14.79	6.71	51.3	75.4	0.87	43	175	2.8
	Engineers 6	8–9	14.53	6.04	45.9	72.3	0.39	82	133	7.9
C	Battalion combat teams 1	8–9	15.42	6.62	60.3	62.3	0.7	82	174	4.3
	Battalion combat teams 2	12–14	14.09	6.79	47	78.8	0.39	153	160	3.9
D	Headquarters troops 1	9	15.48	6.74	52	71.2	0.65	165	309	5.1
E	Battalion combat teams 1	23–25	14 88	7.02	68.4	53.7	0.48	47	151	3.3
Total		180–202								
	Constabulary									
A	Trainees	4	13.82	6.74	47	67	0.3	107	187	10.2
	Headquarters troops	4–6	13.78	6.25	56.2	81.2	0.44	66	187	5.2
B	Company 1	4	14.32	5.82	47	99.5	0.37	66	142	5.2
	Company 2	4–6	14.53	5.88	44.5	96.2	0.14	142	174	7.9
C	Company 1	5	15.6	6.23	57	58.5	0.48	42	133	4
D	Company 1	4	15.08	6.74	50.8	44.5	0.68	200	214	11.8
	Company 1	13–14	15.74	6.43	52	54.5	0.74	54	292	5
	Company 3	11	16.33	6.9	47.5	53.6	0.61	37	201	5
	Company 4	12–13	16.12	6.62	53.9	47.6	0.47	77	182	7.9
E	Company 1	8	15.01	6.74	56.4	58.3	0.64	55	160	6.6
	Company 2	8	15.26	6.65	54.5	42	0.39	37	133	5.9
	Company 3	16–17	15.11	6.11	49.1	54.5	0.64	165	225	3.2
	Company 4	9	14.09	6.70	54.8	60.1	0.18	47	174	2.3
Total		102–109								
	Air Force									
A	Base 1	7–8	15.08	6.28	43.2	83.2	0.56	60	115	4.8
B	Base 1	11	14.11	5.8	47.9	78.1	0.1	122	153	4.5
E	Detachment 1	11	14.15	6.61	43.8	110	0.2	62	167	2.3
Total		29–30								
	Navy									
A	Ship	20–21	14.03	6.51	45.8	97.3	0.56	93	126	4.3
E	Shore	4–6	14.03	6.07	50.3	77.8	0.43	109	187	4.3
Total		24–27								

TABLE XXIV
Guide Used in Interpretation of Data on Blood and Urine in Young Adult Males

Data	Deficient	Low	Acceptable	High
		Blood		
Hemoglobin (gm./100 ml.)	<12.0	12.0–13.9	14.0–14.9	≥ 15.0
Total serum protein (gm./100 ml.)	< 6.0	6.0–6.39	6.4–7.1*	≥ 7.2*
Serum vitamin A (μg./100 ml.)	<10	10–19	20–49	≥ 50
Serum carotene (μg./100 ml.)	<20	20–39	40–99	≥100
Serum ascorbic acid (mg./100 ml.)	< 0.10	0.10–0.19	0.20–0.39	≥ 0.40
		Urine		
Thiamine (μg./gm. creatinine)	<27	27–65	66–129	≥130
Riboflavin (μg./gm. creatinine)	<27	27–79	80–269	≥270
N′-methylnicotinamide (mg./gm. creatinine)	< 0.5	0.5–1.59	1.60–4.29	≥ 4.30

* These categories differ slightly from those proposed by the ICNND Manual, but do not in any way affect the interpretation of the data presented in this report.

Parasitologic examinations were made at the Institute of Hygiene of the University of the Philippines where stool specimens were examined. Serum cholesterol levels were measured in the Biochemistry Department of the College of Medicine, University of the Philippines. The methods used in these ancillary investigations will be described in the separate papers which present these studies.[28,29]

Results

Urine and blood specimens were obtained from 366 of the 1,333 subjects given regular detailed physical examinations. The frequency of clinical findings in this group was similar to that encountered in the total group examined, an indication that a random biochemical subsample had been obtained. Contrary to expectations, the biochemical findings for a "special" group, selected for study because of one or another clinical finding, did not differ from those of the whole sample and did not correlate with the physical findings. The results summarized in Tables XX through XXIII are interpreted in accordance with the standards proposed by the ICNND (Table XXIV and Fig. 3).

The mean hemoglobin level was 14.7 gm. per 100 ml., and only 1.1 per cent of the men examined had hemoglobin values of less than 12 gm. per 100 ml. However, 30.6 per cent fell within the range of 12 to 13.9 gm. per 100 ml., which is considered "low" by ICNND standards. As a group, those in the Philippine Constabulary had a higher mean hemoglobin level (15.19 gm. per 100 ml.) than did the men in the other services (Table XXI), this being a reflection of the high hemoglobin levels which were present for two of their companies. New recruits (trainees) who had been in the military service for less than three months showed somewhat lower hemoglobin levels than did men with greater length of service, but the difference was not statistically significant.

The mean plasma protein level was 6.5 gm. per 100 ml. The plasma protein levels of 10.1 per cent of those examined were less than 6 gm. per 100 ml. (considered "deficient" by ICNND standards), with another 43.2 per cent in the "low" range of 6.1 to 6.3 gm. per 100 ml. The plasma protein levels of men in the Navy and Air Force appear to be slightly lower than those of men in the Army and Constabulary, but other generalizations cannot be made from the data.

Serum vitamin A levels were uniformly good, the mean being 49.3 μg. per 100 ml. No values fell below 10 μg. per 100 ml. and only 1.1 per cent were in the range of 10 to 19 μg. per 100 ml. Constabulary and Army personnel stationed in one location had levels that were somewhat higher than those found elsewhere.

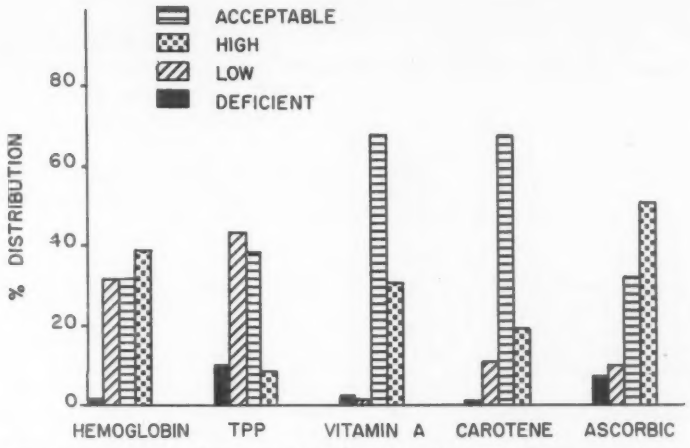

FIG. 3A. Per cent distribution of biochemical values (Philippine survey blood levels).

Although the mean serum carotene level of 72.6 μg. per 100 ml. may be considered high, the distribution of values differed markedly from those of vitamin A. Some 12.3 per cent of the findings fell in the "deficient" (less than 20 μg. per 100 ml.) or "low" (20 to 39 μg. per 100 ml.) ranges. The men in the Air Corps and Navy had the highest carotene levels and the lowest values recorded were found in the Constabulary units stationed at locations D and E. Carotene is a more sensitive reflection of recent dietary intake than is the estimation of vitamin A.

The mean ascorbic acid level in serum was 0.46 mg. per 100 ml. Of all determinations 7.2 per cent were in the "deficient" range (less than 0.1 mg. per 100 ml.) and 9.9 per cent were between 0.10 and 0.19 mg. per 100 ml., which is the "low" range. There was a remarkable variation in serum ascorbic acid levels from location to location, a finding which re-emphasized the variations in dietary quality from place to place. Units stationed in several locations had uniformly low serum levels of this nutrient Of the four services, the Navy personnel had the highest serum ascorbic acid levels while the Air Force had the lowest.

The median thiamine excretion for the entire group was 89 μg. per gm. of creatinine. Of all determinations 13.5 per cent were in the "deficient" range (less than 27 μg. per gm. creatinine) and another 27.9 per cent were in the "low" range (27 to 65 μg. per gm. creatinine). Thiamine excretion was found to be above average in Army personnel stationed in the Manila area where enriched rice was available, but generally there was considerable variation in excretion from location to location For example, in three of four Constabulary units stationed in one location excretion of

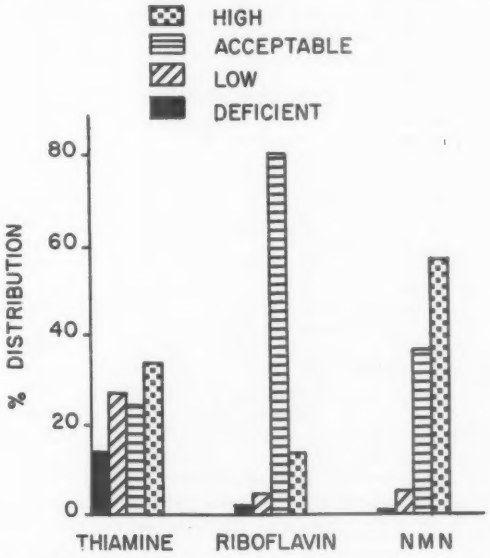

FIG. 3B. Per cent distribution of biochemical values (Philippine survey urine excretion levels).

TABLE
Food Values for the Philippines as Determined

Description*	Edible Portion (gm. %)	Calories (per 100 gm.)	Moisture (gm. %)	Protein (gm. %)	Fat (gm. %)	Ash (gm. %)
Anchovy, long jawed (dried dilis) (AP)	100	331	16.7	68.7	4.2	13.3
Anchovy, long jawed salted and fermented (Bagoong idsa) (EP)	100	70	64.3	14.3	1	20.6
Banana saba (Saging saba) (AP)	56	66	42.5	0.7	0.3	0.4
Barracuda, stripped (Torsillo) (EP)	51	88	78.1	18.8	0.9	1.1
Bilimbi (Kamyas) (EP)	100	22	93.9	0.7	0.4	0.4
Bread, Pan de Agua	100	324	25.5	9.1	4.9	0.7
Bread, Pan de sal	100	320	23.8	9.6	2.9	1.2
Cavalla, Banded (Talakitok) (EP)	54	139	71.5	19.6	6.1	1.1
Chili pepper (Siling labuyo) (EP)	85	103	71.2	4.7	2.4	1.8
Clam (Tulla) (EP)	32	81	81.8	6.2	1.6	0.7
Cocohoney (matamis na bao) (EP)	100	578	3.4	5.4	39.5	1.6
Coconut candy (Bukayo)	100	403	1.7	2.25	2.1	1.3
Common Slipmouth (Sapsap) (EP)	31	91	77.1	17.5	1.8	1.3
Crevalle (Salaysalay) (EP)	56	92	76.5	19.4	1	1.5
Ensaymada (sweet roll)	100	346	20.9	7.4	5.3	0.5
Fish sauce (Patis)	100	59	63.6	9.9	0.1	22.6
Flat-headed goby (Biang puti) (EP)	39	86	76.9	19.7	0.2	1.2
Goat fish (saramulyete) (EP)	39	92	78.1	18.1	1.3	1.2
Grunt Silver (Ayngin) (EP)	51	205	26.6	38.7	3.7	26.8
Guava jelly (EP)	100	369	16.6	0	0.7	0.03
Hopia (Munggo) (EP)	100	390	16.1	4.9	11.2	0.6
Horse radish (Malunggay) (EP)	64	76	77.5	5.7	1.9	2.1
Jackfruit (Langka) green (EP)	60	51	85.1	2	0.6	0.7
Kalamansi juice (EP)	40	38	89.8	0.3	0.6	0.4
Mackerel, stripped (alumahan) (EP)	62	118	76	21.5	2.9	1.2
Milkfish (gangus) (AP)	68	82	72.2	11.1	3.9	1.1
Milk fudge (pastillas de leche)	100	384	4.5	7.6	0.8	0.5
Dalag (EP)	64	74	69.4	17.2	0.1	1.3
Onion leaves (Sibuyas dahon) (EP)	67	29	91.6	1.8	0.7	0.7
Papaw, green (papaya hilaw) (EP)	76	26	92.3	21	0.1	0.6
Pepper leaves (sili talbos) (EP)	38	50	83.4	6.3	1.2	2.2
Pork fat (Mantika)	100	901	...	0.1	99.9	0
Pork liver (Baboy, atay) (AP)	...	119	73.3	16	2.8	1.3
Rice noodle (Bihon)	100	360	12.9	4.7	0.1	0.2
Scad, big eyed (matang baka) (EP)	50	76	79.8	17.5	0.1	1.8
Scar (Galongong) (EP)	41	94	73.9	18.8	1.5	1.2
Sea Bass (apahap) (EP)	55	80	77.9	17.8	0.4	1.1
Small shrimps, salted and fermented (Bagoong alamang) (EP)	100	73	63.3	14.9	1	20.6
Soursop (Guwayabano) (EP)	70	46	86.7	0.9	0.1	0.5
Spanish mackerel (Tangingi) (EP)	94	70	82.1	15.9	0.2	1.6
Taro (Babi) (EP)	82	93	75.5	2.3	0.3	0.9
Tuna, bonito (Tulingan) (EP)	55	130	70.2	25.8	2.2	1.3
Wheat noodles (Misua) (EP)	100	350	11.3	12.1	0.1	3.7
Yam milk fudge (ubedol sweet)	100	346	8.7	6.7	1.6	1.8
Yam (Ube) (EP)	85	107	71.9	2.2	0.1	1.0
Young herring (silinyasi) Tunsoy (EP)	53	97	75.1	21.9	0.4	1.9

*AP = As purchased. EP = Edible portion.

XXV
by the Institute of Nutrition, Manila

Constituents									
Carbohydrate (by difference, gm. %)	Crude Fiber (gm. %)	Calcium (mg. %)	Phosphorus (mg. %)	Iron (mg. %)	Vitamin A (I.U.)	Thiamine (mg. %)	Riboflavin (mg. %)	Niacin (mg. %)	Vitamin C (mg. %)
...	...	2,381	1,489	23.4	...	0.01	0.23	7.5	...
...	...	535	313	10.9	...	Trace	0.13	3.8	...
17.1	0.3	13	20	0.5	176	0.03	0.02	0.3	16
...	...	58	162	0.6	...	0.02	0.05	3.5	...
4.6	0.6	7	13	0.8	170	0.01	0.03	0.3	10
59.8	...	24	82	3.5	...	0.16	0.09	3.2	...
62.5	...	34	80	2.4	...	0.18	0.16	2.3	...
...	...	64	186	0.8	...	0.12	0.08	5.5	...
19.9	6.5	45	85	2.5	11,050	0.24	0.29	2.1	70
9.7	...	176	77	1.7	...	Trace	0.16	1.2	...
50.1	...	27	144	4.2	...	0.003	0.135	1	...
93.89	9.36	73	56	0.99	...	0.04	0.08	0.8	...
...	...	50	148	Trace	...	0.01	0.04	2.1	...
...	...	93	221	1.3	...	0.02	0.12	4.2	...
65.9	...	25	55	2.1	...	0.12	0.17	2.6	...
3.8	...	37	36	2.8	...	Trace	0.08	4.4	...
...	...	74	133	0.4	...	0.02	0.09	2.5	...
...	...	91	170	0.9	...	0.03	0.04	1.4	...
4	...	5,219	996	18.3	...	0.03	0.35	4.6	...
90.7	...	3	Trace	0.5	...	0.01	0.01	0.2	...
67.2	1	23	82	0.5	...	0.13	0.12	1	...
12.8	1.9	390	97	2.8	13,755	0.20	0.64	3.4	238
11.6	2.6	53	20	0.14	58	0.12	0.05	0.5	13
8.9	0	22	12	1.5	0	0.02	0.01	0.1	43
...	...	47	197	1.4	...	0.03	0.07	9.4	...
...	...	35	162	0.2	...	0.01	0.03	4.4	...
86.6	...	215	107	0.5	...	0.06	0.15	0.3	...
...	...	62	176	0.9	...	0.04	0.02	5.8	...
5.2	1.2	55	39	7.2	1,365	0.09	0.09	0.6	37
4.9	0.1	50	23	0.4	...	0.02	0.02	0.2	19
6.9	1	264	56	1.3	11,505	0.52	0.34	1.9	77
0	0	0	0	0	0	0	0	0	0
6.6	...	12	184	0	(14,200)	0.37	2.59	8.1	...
82.1	0.2	6	35	1.8	...	0	0.01	0.1	...
...	...	50	115	0.4	...	0.03	0.08	3.2	...
...	...	74	212	0.9	...	0.14	0.19	8.7	...
...	...	46	150	0.3	...	0.05	0.06	3.1	0
0.2	...	469	228	5.4	...	0.01	0.10	1.6	0
11.8	0.7	14	26	0.8	...	0.08	0.02	0.7	30
0	...	23	236	1.0	...	0.02	0.09	13.2	0
21	0.5	33	66	1.0	Trace	0.14	0.04	0.7	10
...	...	23	215	5.3	...	0.04	0.14	15.6	...
72.8	...	55	74	2.1	...	0.24	0.03	3.2	0
81.2	...	78	65	2.6	...	0.07	0.15	0.3	...
24.8	0.8	15	53	0.9	0	0.06	0.03	0.5	4
...	...	205	233	1.3	...	0.01	0.05	6.3	...

thiamine was low whereas the median excretion in the fourth unit was extremely high. As a group, the recent Army inductees (trainees) excreted the most thiamine.

The median riboflavin excretion was 158 μg. per gm. creatinine. Only 2 per cent of the men examined excreted amounts of riboflavin that could be classified as "deficient" (less than 27 μg. per gm. creatinine); another 4.4 per cent were in the "low" range (27 to 28 μg. per gm. creatinine). Any differences in excretion rates among various groups were not significant.

Urinary excretion rates of N′-methylnicotinamide were uniformly good, with an over-all median of 4.8 mg. per gm. creatinine. Only 0.6 per cent of all values were in the "deficient" range (less than 0.5 mg. per gm. creatinine) and 3.9 per cent in the "low" range (0.5 to 1.4 mg. per gm. creatinine). The Air Force had a greater preponderance of low values than did the other services.

Of 263 specimens examined for parasites, 76.8 per cent were positive for trichuris, 59.3 per cent for hookworm, and 39.5 per cent for ascaris. Of the trichuris infestations 89 per cent were light, as were 97 per cent of the hookworm, and 99 per cent of the ascaris infestations. Further discussion of the parasitologic study will be found in the report of that study.[28]

The serum cholesterol levels varied from 78 to 353 mg. per 100 ml., with a mean of 171 mg. per 100 ml. The values increased with age and were positively correlated with serum carotene levels. There was slight correlation with serum vitamin A levels and with diastolic blood pressure, but not with hemoglobin levels. Details of this study will be found in the accompanying paper.[29]

Generally speaking, no biochemical differences existed between men eating in military mess halls and men who were given a cash ration. The absence of a difference is attributable to the dependence of both groups on the locally available food supply. Although the Navy seemed to have a relatively high biochemical index of nutriture and the Air Corps lowest, no one service was uniformly superior or inferior to the others.

DIETARY SURVEY

A variety of methods was used to obtain data on food and nutrient intake. Detailed surveys were conducted in nine military messes, among which complete records were made of kinds and amounts of foods prepared, served, left-over and wasted. A head count at each meal determined the number of men present for meals. From these data the average amount of food consumed per man per day was calculated. Nutrient intake was calculated from tables of food composition developed for the Philippines by the Institute of Nutrition (Table XXV) and from the U. S. Department of Agriculture's Handbooks 8 and 34.[30,31]

During each mess survey a composite of the cooked food was prepared for chemical analysis. At two of the messes composites of raw food were also taken in order to estimate cooking losses. The composites were prepared as follows: approximately one serving of each food was set aside at each meal, inedible parts were removed, and each food was homogenized separately in a Waring Blendor without addition of water. One-tenth of the amount of food consumed by one man was weighed out daily, and the aliquots were combined to make the master composite. For vitamin A analysis alcoholic potassium hydroxide was added to the aliquot. For all other analyses the aliquot was treated with oxalic acid.

In order to make comparisons with the detailed surveys and to determine seasonal variations, amounts of foods purchased or issued for some period prior to the survey were determined from the mess records. Since some items, such as fruits and vegetables, were purchased and recorded by piece rather than by weight or volume, approximations had to be made for them in calculating food purchased per man per day. Estimates of nutrient composition were also made in this manner at a number of other messes which were visited too briefly to permit a detailed survey.

Some of the men at each mess were interviewed by dietitians in order to determine the approximate amounts of foods and beverages consumed outside of the mess. Each man was asked to recall food and beverage items consumed between meals during the previous

TABLE XXVI
Average Daily per Capita Consumption at Infantry Training Base
(Comparison of Data from Different Methods of Study)

Method of Evaluation	No. of Persons	Calories	Protein (gm.)	Carbohydrate (gm.)	Fat (gm.)	Calcium (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine* (mg.)	Riboflavin* (mg.)	Niacin* (mg.)	Vitamin C* (mg.)
Chemical analysis of 3-day food composite	...	3,027	94.1	540	54.5	1,189	22.3	...	1.98	0.99	29.7	74
Food inventory, 3 day	730	3,455	86.9	640.5	68.4	360	28.2	4,510	3.40	0.91	32.6	73
Recipe method, 3 day	730	3,439	84.5	623	62.5	305	26.3	3,926	3.38	0.88	32.5	71
Food issues, 9/56†	724	1,850	59.8	277.6	54.1	262	14.1	3,718	1.63	0.72	17.9	58
Food issues, 10/56	721	4,125	94.8	733.5	85.1	521	29.9	6,902	3.67	1.14	33.9	83
Snacks eaten away from mess	72	26	0.4	5.6	0.4	6	...	0	...	0.01	...	0

*No correction of cooking losses.
† Low values obtained due to small amount of rice reported in food issue record.

TABLE XXVII
Average Daily per Capita Consumption at Air Force Base
(Comparison of Data from Different Methods of Study)

Method of Evaluation	No. of Persons	Calories	Protein (gm.)	Carbohydrate (gm.)	Fat (gm.)	Calcium (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine* (mg.)	Riboflavin* (mg.)	Niacin* (mg.)	Vitamin C* (mg.)
Chemical analysis of 2-day food composite	...	2,059	77.4	394	19.3	1,354	28.1	2,867	1.06	0.88	15.8	35
Food inventory, 2 day	304	2,503	67.2	479.5	32.5	527	22.8	3,503	2.39	0.62	24.2	87
Recipe method, 2 day	304	2,490	67.3	477.9	30.2	533	22.6	3,246	2.41	0.59	24.4	80
Food issues, 12/56	299	5,277	134	121	897.7	636	39.6	6,521	4.69	1.41	49.2	95
Food issues, 1/57	220	4,211	102.5	736.1	90.4	630	32.1	5,675	3.74	1.03	39.4	112
Snacks eaten away from mess	50	222	4.9	36.1	6.2	57	0.5	157	0.04	0.08	0.8	0

* No correction of cooking losses.

twenty-four hours. From these data average intake of snacks per man was calculated.

A few of the enlisted men on cash rations who ate with their families were interviewed, and asked to recall all items consumed during the previous twenty-four-hour period. Estimates of quantity and cost were recorded and average food consumption per day was calculated. Only a small sample was so interviewed, since this was a time-consuming study and the detailed mess surveys were given greater priority.

In general, all messes obtained food by local purchase on a cash basis. Each mess was allowed 1 peso (official rate: 2 pesos = $1.00 U. S. currency) per man per day and had to maintain complete financial records to show the disposition of such funds. Supplementary allowances were available for men during field operations and for hospital patients. Since refrigerated storage facilities were rare, perishable foods were purchased daily at the local market. Some messes stocked non-perishable foods; others purchased them daily. Central food storage was not available, and central procurement was practiced at only two locations. A large proportion (40.2 per cent of the men given detailed physical examinations) of the men of the Armed Forces of the Philippines receive an individual cash ration allowance and procure their own food. These are usually married men living in homes adjacent to the post. In general, their food was similar to that served in the messes, since mess supplies and those for the home kitchen were both purchased locally.

Although there is a school for cooks and bakers in one location, few mess personnel have attended it or have received adequate training in food preparation and service. No master menu was regularly issued by the Armed Forces of the Philippines. A few individual posts did plan advance menus.

Summaries of the nutritional evaluations of food intake for two representative mess surveys are given in Tables XXVI and XXVII. Values are given for the chemical analysis of

TABLE XXVIII

Average Daily per Capita Consumption by Recipe Method

Unit and Date	Average No. of Men Fed Daily	Calories	Protein (gm.)	Fat (gm.)	Carbohydrate (gm.)	Calcium (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine* (mg.)	Riboflavin* (mg.)	Niacin* (mg.)	Vitamin C* (mg.)
Training Battalion, Infantry Division, Feb. 1957 (3 days)	730	3,439	84.5	62.5	623.0	305	26.3	3,926	3.38	0.88	32.5	71
Air Force Base, Feb. 1957 (2 days)	304	2,490	67.3	30.2	477.9	533	22.6	3,246	2.41	0.59	24.4	80
Engineering Combat Team, Feb. 1957 (2 days)	73	2,995	69.8	73.3	500.6	254	10.4	1,615	1.41	0.61	16.7	61
Ordnance Personnel, Feb. 1957 (1 day)	32	2,225	56.9	24.5	434.9	1,077	11.2	1,658	0.99	0.50	14.8	61
Constabulary Personnel, March 1957 (2 days)	17	2,308	72.4	33.1	420.3	185	12.8	761	0.79	0.66	26.4	22
Constabulary Personnel, March 1957 (2 days)	19	2,719	74.5	35.7	514.2	201	14.4	1,895	0.97	0.8	25.5	34
Ordnance Personnel, March 1957 (3 days)	33	2,518	71.9	51.9	432.5	244	10.8	1,841	1.21	0.67	18	50
Signal Personnel, March 1957 (2 days)	215	2,732	77.8	35.2	514.3	279	11.3	4,738	1.14	0.73	19	63
Medical Detachment, March 1957 (2 days)	76	2,603	81.5	50.2	447.2	397	12.3	1,354	1.02	0.75	23	42

* No consideration of cooking losses.

TABLE XXIX

Average Daily per Capita Consumption by Chemical Analysis of Food Composite

Unit	Quantity per Man per Day (gm.)	Total Calories	Protein (gm.)	Fat (gm.)	Carbohydrate (gm.)	Calcium (mg.)	Phosphorus (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine (mg.)	Riboflavin (mg.)	Niacin (mg.)	Vitamin C (mg.)
Training Battalion, Infantry Division	2,477	3,027	94.1	54.5	540	1,189	520	22.3	...	1.98	0.99	29.7	74
Air Force Base	1,759	2,059	77.4	19.3	394	1,354	1,091	28.1	2,867	1.06	0.88	15.8	35
Engineering Combat Team	1,890	3,026	81.3	69.9	517.9	1,077	1,096	34	2,948	0.76	0.57	17	38
Ordnance Personnel	1,890	2,412	92.6	22.7	459.3	1,210	1,153	17	2,967	0.38	0.57	13.2	38
Constabulary Personnel	1,601	1,960	92.9	25.6	339.4	1,089	1,217	22.4	2,818	1.28	0.96	25.6	16
Constabulary Personnel	1,759	2,540	128.4	21.1	459.1	545	1,126	28.1	3,219	1.41	0.7	22.9	18
Ordnance Personnel	1,927	2,533	133	27	439.4	1,407	1,330	21.2	4,528	0.96	0.96	19.3	39
Signal Personnel*	1,129	3,692	94.8	7.9	810.6	598	1,219	22.6	4,432	1.02	0.9	15.8	56
	1,943	3,571	118.5	19.4	730.6	894	1,146	35	4,391	0.58	0.58	17.5	78
Medical Detachment*	1,024	2,639	107.5	13.3	522.2	655	1,331	21.5	2,806	1.23	0.92	20.5	72
	1,680	2,612†	124.3	8.4	510†	722	1,042	30.2	3,226	0.67	0.5	10.1	50

* Figures on first line represent values for raw food; those on the second line, for cooked food.
† Estimated value.

food samples, food inventory method, recipe method, snacks eaten outside the mess, food issues and household survey in so far as information could be obtained for each location. Similar information on the remaining messes surveyed are detailed in the official report.

It is of interest to compare the information obtained by the several technics employed. The inventory and recipe methods of calculation agree well with each other, but the analytic values are often quite different. Some of these differences may be due to sampling procedure, but some appear to be regular, not random. changes, suggesting either changes in cooking methods or errors in the tables of food composition.

Protein content was regularly higher and fat content lower by chemical analysis as compared to calculated values. This lower fat content by analysis may be due to incomplete extraction of the composite. However, since the analytic methods are reasonably precise, more credence should be given to them. Analytic values for carbohydrate vary in both directions from the calculated ones. Since carbohydrate is determined by difference, the calculated

values are judged to be more reliable for this nutrient. The major differences between analytic and calculated figures for calories are generally accounted for by variation in carbohydrate content.

The inventory and recipe as compared to analytic methods gave lower values for dietary calcium (eight of nine were below 0.8 gm. per day), while the intake estimated from the analytic results was good (only one of nine being significantly below 0.8 gm. per day). Tap water was used to dilute the composites for analysis and extra calcium might have been introduced from this source. A day's 10 per cent composite was made up to 500 gm. with water. If the amount of water added was as much as 400 ml. and the calcium concentration in the water was as high as 50 mg. per l., the increase in apparent dietary calcium would have been only 200 mg., while the differences between analytic and calculated calcium actually average 650 mg. It seems more likely that these differences are real. Extra calcium may have come from water added for cooking, or from the unrefined sea salt used for flavoring. While it is not possible to identify the source of this discrepancy, the analytic values are judged to be the more reliable estimates of calcium intake.

The analytic values for iron were also regularly higher than the calculated ones. Although this difference could be due to errors in food composition tables, the iron probably was added during cooking, especially since cast iron pots are used in many messes. Support for the latter explanation comes from the observed higher content of iron in the cooked food as compared to the raw food (Tables XXVIII and XXIX).

Analytic values for vitamin A were higher in six of eight diets than the calculated values. Thiamine values were lower by analysis than by calculation in seven of nine diets. In the two messes tested cooking losses of thiamine were 40 per cent. Riboflavin content of the diets was substantially the same by analysis and calculation. Cooking losses of riboflavin were similar to those of thiamine. Niacin content was approximately the same by all methods. Analytic values for vitamin C averaged 25 per cent lower than the calculated values. These may represent cooking losses, but in the two cases in which it was tested one diet "gained" and the other "lost" vitamin C during cooking. It seems reasonable to accept the analytic results as the better approximations of intake for the vitamins.

TABLE XXX

Average Daily per Capita Nutrient Intakes, Nine Messes

Nutrient	Chemical Analysis of Cooked Composites	Analysis by Recipe Method
Calories	2,638	2,670
Protein (gm.)	105	73
Carbohydrate (gm.)	488	485
Fat (gm.)	30	44
Calcium (mg.)	1,054	388
Iron (mg.)	26	15
Vitamin A (I.U.)	2,496	2,337
Thiamine (mg.)	1.01	1.48*
Riboflavin (mg.)	0.75	0.69*
Niacin (mg.)	19	22*
Vitamin C (mg.)	43	54*

* No consideration of cooking losses.

The average nutrient intakes for all nine messes, determined by chemical analysis of the cooked food composite and the recipe method, are shown in Table XXX. The caloric intake divided by the average weight of the men examined gives a figure of 45 to 47 calories per kg. body weight per day, which is adequate for moderate work. The quantity of protein consumed by each man each day was adequate in all units surveyed. Principal sources of protein were rice, fish, pork, beef, eggs and bread. Protein from animal sources constituted 33 to 48.8 per cent of the total protein, the average being 40.2 per cent. Fat intake was "low," being between 10 and 15 per cent of the total calories. Calcium, as indicated, was "low" by the recipe method, but was good by chemical analysis. Intake of iron and niacin was satisfactory. Intake of vitamin A, thiamine and riboflavin was "low," and of vitamin C borderline, judged according to ICNND standards.

Tables XXVI and XXVII give detailed results for two representative messes. Soldiers in the first location (Table XXVI) were in basic training and very active. Levels of intake of

TABLE XXXI
Average Daily per Capita Consumption by Food Issue Method

Unit and Date	Average Daily Head Count	Calories	Protein (gm.)	Fat (gm.)	Carbohydrate (gm.)	Calcium (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine* (mg.)	Riboflavin* (mg.)	Niacin* (mg.)	Vitamin C* (mg.)
Training Battalion, Infantry Division												
Sept. 1956†	724	1,850	59.8	54.1	277.6	262	14.1	3,718	1.63	0.72	17.9	58
Oct. 1956	721	4,125	94.8	85.1	733.5	521	29.9	6,902	3.67	1.14	33.9	83
Air Force Base												
Dec. 1956	299	5,277	134	121	897.7	636	39.6	6,521	4.69	1.41	49.2	95
Jan. 1957	220	4,211	102.5	90.4	736.1	630	32.1	5,675	3.74	1.03	39.4	112
Engineering Combat Team												
Jan. 1957 (3 wk.)	72	3,938	94.1	83.9	683.6	326	14.4	1,200	1.85	0.78	22.1	42
Feb. 1957 (3½ wk.)	69	4,614	107	90	723.3	380	17.1	1,598	1.98	0.84	24.6	53
Ordnance Personnel												
Feb. 1957	29	4,541	103	59.2	877.4	716	16.1	3,116	1.85	0.8	24.9	69
Constabulary Personnel												
Feb. 1957 (3½ wk.)	25	3,822	84	24.8	798.9	274	14.8	1,074	1.46	0.97	19.9	21
Ordnance Personnel												
Feb. 1957	26	3,589	90	59.3	658.1	245	11.2	1,385	1.94	0.81	22.4	28
Signal Personnel												
March 1957 (3 wk.)	209	4,168	110.5	53.9	789.1	434	17.4	3,833	1.6	0.94	29.1	55
Medical Detachment												
March 1957 (4 wk.)	71	4,738	108.7	77.3	887.3	560	21	5,166	1.89	1.2	25.5	93

* No consideration of cooking losses.
† Calculated figures are low because amount of rice listed in food issue record was probably not the total for the whole month. The quantity of rice per man per day was found to be only 128.94 gm.

TABLE XXXII
Average Daily Nutrient Intake and Cost per Man
(Household Survey)

Unit	Total No. Interviewed	Calories	Protein (gm.)	Fat (gm.)	Carbohydrate (gm.)	Calcium (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine* (mg.)	Riboflavin* (mg.)	Niacin* (mg.)	Vitamin C* (mg.)	Average Daily Food Cost
Training Battalion, Infantry Division	4	2,388	69.2	53	402.7	418	8.8	6,593	0.98	1.67	16.8	42	1.13
Air Force Base	5	3,071	84.7	77.1	503.2	270	11	1,882	1.27	0.79	18.2	38	0.89
Engineering Combat Team	7	2,516	67.3	42.2	456	393	9.5	3,870	1.04	0.64	14.3	30	0.76
Ordnance Personnel	7	2,525	72.3	52	410.3	409	10.1	2,576	1.04	0.81	16.1	36	0.83
Medical Detachment	5	2,802	74.1	45.8	514.5	374	10.9	2,810	1.2	0.8	16.2	54	0.88
Average of all units	28	2,650	73.1	53.1	455.8	375	10	3,391	1.1	0.89	16.1	39	0.88

* No consideration of cooking losses.

all nutrients except riboflavin were satisfactory. The calculated calcium intake was "low." Quantity of nutrients obtained from snacks outside the mess was small because the trainees were restricted to the camp area. Most of the food consumed outside the mess was sent in by friends or relatives.

Members of the mess tabulated in Table XXVII were primarily ground personnel of an air force base. Their food was purchased daily from a metropolitan market. Except for vitamin A and riboflavin the intake of nutrients was adequate. The calculated intake of calcium was "low." The caloric value of the food consumed in the mess was "low," but the supplementary intake of calories in snacks made the total intake satisfactory for moderate activity.

Since the time schedule did not permit detailed surveys in all locations, food issue records were tabulated and evaluated nutritionally for ten other messes. Nutritional values calculated from food issue records are not precise and must be considered as rough estimates. These values lack accuracy mainly because no correction is made for food waste and records were inadequate so far as weight or volume of food used was concerned. Many vegetables or fruits are sold by the piece or bunch and the purchases are so recorded. Average weights

TABLE XXXIII
Average Daily per Capita Consumption of Snacks Away from Mess Hall

Unit and Date	No. of Men	Calories	Protein (gm.)	Fat (gm.)	Carbohydrate (gm.)	Calcium (mg.)	Iron (mg.)	Vitamin A (I.U.)	Thiamine* (mg.)	Riboflavin* (mg.)	Niacin* (mg.)	Vitamin C* (mg.)
Training Battalion, Infantry Division, Feb. 1957	72	26	0.4	0.4	5.6	6	0	...	...	0 01	...	0
Air Force Base, Feb. 1957	50	222	4.9	6.2	36.1	57	0.5	157	0.04	0.08	0 8	0
Engineering Combat Team, Feb. 1957	15	40	0.3	0.5	9.9	1	...	...	...	...	...	..
Ordnance Personnel, Feb. 1957	11	236	7.4	5.1	51.3	46	0.8	74	0.09	0.19	2.1	..
Ordnance Personnel, March 1957	10	135	4.1	6.6	25.1	59	0.6	144	0.10	0.17	0.1	1
Medical Detachment, March 1957	20	302	9.8	11.7	41.3	206	1.4	847	0.12	0.35	1.1	8

* No consideration of cooking losses.

have to be assumed for all items not recorded by weight or volume, and the validity of the estimates cannot be verified. Nevertheless, evaluation of the food issue records generally shows the same trends as the detailed mess surveys. The intakes of calcium, vitamin A, thiamine and riboflavin were low. Detailed results for each mess are shown in Table XXXI.

Twenty-eight men were interviewed who received theirrations as cash and ate their meals at home. Data obtained included age, size of family, family income and daily expenditure for food, and the usual food intake pattern. Each man was asked to recall what foods and how much of each he had eaten during the previous twenty-four hours. The nutrient composition of the food was estimated from tables of food composition. When complex dishes had been eaten the food composition was estimated from typical recipes. Results of the household surveys are detailed in Table XXXII.

The majority of the men eating at home had no income beyond their military pay and cash ration allowance of 1 peso per day. Their average daily cash expenditure for food was 0.88 pesos per man, computed on the basis that all foods were purchased. However, 14 per cent of the men kept vegetable gardens, or could obtain rice without cost, or both. Seven per cent of the men kept poultry or pigs. The average daily food expenditure per household (2.42 pesos), divided by the average number of persons per household (5.3), gives an average food expenditure per person of only 0.46 pesos. In general, these expenditures for food paralleled individual income levels.

There was great similarity in the diet patterns of these men who ate their meals at home. Rice and fish were the predominant items in their meals. Seventy-five per cent of the men ate fish daily. Very few meat or dairy products were consumed, probably because of their high cost. However, 89 per cent of the men interviewed used some canned milk daily, primarily to flavor coffee. Canned milk was also used in the household for infant feeding. A large number (71 per cent) of the men used vegetable

TABLE XXXIV
Summary of Daily Food Waste at Various Locations

Unit	Location Code	Number of Rations	Plate Waste (%)	Kitchen Waste* (%)	Total Waste per Man (lb.)
Training Battalion, Infantry Division	A 1	2,191	2.1	3.4	0.184
Air Force Base	A 1	604	11.8	5.6	0.393
Engineering Combat Team	B 6	147	8.8	8.6	0.524
Ordnance Personnel	B 3	31	12.9	10	0.763
Constabulary Personnel	E 1	37	10.3	18.1	0.909
Constabulary Personnel	E 2	34	10.2	11.3	0.686
Ordnance Personnel	D 1	98	6.3	18.2	0.861
Signal Personnel	A 4	429	8.3	5	0.428
Medical Detachment	A 3	152	10.2	18.3	1
Weighted Average			5.3	5.5	0.36

* Kitchen waste includes leftover foods not served in mess.

TABLE XXXV

Diet Patterns of Three Different Messes Surveyed (Recipe Method)
Average Daily Food Consumption (gm. per man)

Food	Location			Food	Location		
	A 1	E 2	D 1		A 1	E 2	D 1
Rice:				Fish:			
Enriched	551.47	....	....	Anchovy, long-jawed, salted and fermented (Bagoong Isda)	2.09	....	....
Polished	....	378.59	389.17	Milkfish (Bangus)	73.28	....	....
Bread:				Tuna, bonita (Tulingan)	....	208.70	....
Pan de sal	132.98	40.22	45.04	Scad, big-eyed (Matang-baka)	....	....	48.49
Pan de agua or de lemon	....	....	29.56	Barracuda (Torsillo)	....	....	35.50
Sweet roll (Ensaymada)	....	71.14	17.98	Cavalla, banded (Talakitok)	....	....	78.54
Oatmeal	....	....	7.67	Crevalla (Salaysalay)	....	....	26.56
Macaroni or wheat noodles (Misua)	1.82	....	4.00	Shellfish, shrimp	6.81	....	....
Cornstarch	0.41	....	....	Eggs, duck	16.48	....	....
Beans and legumes:				Oil or fat:			
Cowpeas (Sitaw)	52.35	....	43.77	Lard, vegetable	6.72	1.5	9.67
Mongo sprouts	....	25.79	....	Margarine	....	5.86	1.86
Sweet peas (Sitsaro)	....	....	3.18	Cooking oil (including coconut)	....	3.09	1.14
Root (starchy) vegetables:				Milk, evaporated	16.75	21.97	25.29
Yam (Ube)	....	....	19.70	Fruit:			
Yellow sweet potato (Kamote)	34.37	....	....	Balsam pear (Ampalaya)	12.94	....	....
Potatoes	....	....	4.27	Banana, common	79.22	95.88	144.33
Taro (Gabi)	....	....	8.54	Banana, Saba	10.31	....	....
Green, leafy vegetables:				Papaya, green (Papayang Hilaw)	....	....	21.16
Cabbage, celery (Petsay)	13.26	20.48	....	Bilimbi (Kamyas)	....	....	2.22
Cabbage, common	29.92	....	....	Sweets:			
Horseradish leaves (Malunggay)	....	....	1.04	Sugar			
Other vegetables:				White	....	....	21.66
Onion bulbs (Sibuyas)	9.58	8.90	6.72	Brown	29.78	30.27	....
Green onions (Dahong sibuyas)	....	....	11.30	Fruit, jam	32.32	....	....
Tomatoes	20.84	13.21	12.58	Guava jelly	....	....	2.54
Eggplant (Talong)	42.45	....	9.90	Yam milk fudge (Ubedol sweet)	6.86	....	....
Chayote (Sayote)	31.01	....	9.85	Coconut candy (Bukayo)	7.17	....	....
Calabash (Upo)	77.32	....	1.27	Other:			
Squash, winter (Kalabasa)	....	....	2.00	Soy sauce	9.44	....	2.95
Bamboo shoots	....	31.42	....	Vinegar	0.41	....	....
Pepper, green	....	....	5.04	Coconut milk (Gata)	....	6.17	....
Pepper, red	....	....	0.82	Seaweed	....	....	14.12
Meat:				Catsup, tomato	....	....	1.91
Pork	76.27	....	57.52				
Beef	53.44	65.29	....				
Chicken, dressed	....	....	24.24				

shortening daily. Although some 61 per cent of the men consumed leafy and yellow vegetables daily, the amounts eaten were small and would supply but little carotene. Citrus fruits were in abundant supply in almost all the areas surveyed, but only 7 per cent of the men ate them daily. Either the importance of these fruits as sources of ascorbic acid was not appreciated or their cost restricted their purchase and use. In this regard, it is noteworthy that consumption of soft drinks was common.

Summaries of the average nutrient intake at the various messes surveyed are given in the following tables: by the recipe method, Table XXVIII; by chemical analysis, Table XXIX; by the food issue method, Table XXXI; and

TABLE XXXVI
Diet Evaluations in the Philippines
(Weight in Grams of Foodstuffs)

Food	Present Survey			Previous Surveys		
	Location					
	A 1	E 2	D 1	1948*	1950†	1952‡
Rice:						
White, polished	...	378.59	389.17	380	...	436
Enriched	551.47	...	...	...	380	...
Bread:						
Pan de sal, wheat flour	132.98	40.22	74.60	20	20	17
Sweet roll	...	71.14	17.98	...	...	...
Beans and legumes:						
Mongo, other legumes	52.35	25.79	46.95	30	40	...
Root (starchy) vegetables:						
Mostly yellow sweet potatoes	34.37	...	23.97	25	30	7
Taro	...	...	8.54	...	...	...
Green, leafy vegetables:						
Sweet potato tops	...	...	...	...	...	...
Cabbage, malunggay	43.18	20.48	1.04	25	30	10
Other vegetables:						
Tomatoes, eggplant, onion, squash, bittermelon	181.20	53.53	59.48	40	50	31
Meat:						
Pork, beef	76.27	...	57.52	20	20	17
Beef	53.44	65.29	...			...
Fish:				...	...	
Mostly small fish	75.37	208.70	189.09	150	150	70
Shellfish, shrimp	6.81	...	...	...	...	61
Eggs, duck or hen	16.48	...	...	20	20	3
Oil or fat:						
Coconut oil	...	3.09	1.14	...	...	...
Vegetable lard	6.72	1.5	9.69	20	20	1.3
Margarine	...	5.86	1.86	...	...	...
Milk, evaporated	16.75	21.97	25.29	15	15	...
Fruits:						
Banana, guava, papaya, in season	102.47	95.88	167.71	25	20	30
Sugar:						
Brown	29.78	30.27	...	10	10	9
White	...	...	21.66	...	...	...
Other:						
Oatmeal	...	...	7.67	...	...	...
Chicken	...	...	24.24	...	...	...
Soy sauce	9.44	...	2.95	...	...	...
Seaweed	...	...	14.12	...	...	...
Coconut milk	...	6.17	...	...	...	...
Sweets	46.35	...	2.54	...	...	...

* Institute of Nutrition, Manila, survey data.
† Institute of Nutrition, Manila, resurvey data.
‡ FAO/WHO survey data.

by additional snacks outside the mess hall, Table XXXIII. Typical examples of the average quantity of food and nutrient intake per man per day for two locations are given in Tables XXVI and XXVII.

Edible food loss through plate and kitchen waste varied considerably among messes, ranging from 0.18 pound per man per day at location A1 to 1 pound at location A3, as shown in Table XXXIV.

Diet patterns of three different messes are compared in some detail as to food items in

TABLE XXXVII

Average Weight for Height, AFP Enlisted Men as Compared to Height-Weight Data from Other Sources

Stature (in.)	Average Weight (lb.)				
	Filipinos		A.F.P.	Americans	
	Cordero et al.*	Insurance†	ICNND‡	Light Build§	Medium Build§
59	..	..	105 (107)	..	..
60	110	112	108 (110)	..	..
61	113	114	112 (114)	..	..
62	116	116	115 (117)	121	130
63	120	120	118 (120)	124	133
64	124	124	123 (125)	128	136
65	127	128	125 (127)	132	140
66	131	132	129 (131)	135	143
67	135	136	132 (134)	138	147
68	139	140	134 (136)	142	152
69	143	145	.. ..	147	156
70	147	150	.. ..	151	160

* Cordero et al.[36]

† U. S. Life Insurance Company Standards as quoted in ref. 36.

‡ In this survey individuals were weighed clad only in undershorts. The figures in parentheses are these weights adjusted upward 2 pounds to allow for average light clothing. Combined data, all ages, all subjects examined.

§ Statistical Bulletin, Metropolitan Life Insurance Company.[37]

Table XXXV, and against those of the surveys of 1948, 1950 and 1952 in Table XXXVI.

COMMENT

On physical examination the members of the Armed Forces of the Philippines appeared to be in good condition. The average per cent of standard weight of only 92 is probably an artifact brought about by the improper application of the American Medico-Actuarial Standard Weight Tables[32] to this population. First, for a given height these tables allow a considerable gain in weight with age, doubtless reflecting the obesity in the American population from which the table was made. In the Filipino population, however, older men show little obesity with increasing age, thus the per cent of standard weight must necessarily be low. This factor is not predominant here, however, since the tables allow a weight gain of 13 pounds between twenty and forty years of age at a height of 64 inches, while the observed increase in the Filipinos examined was 9.6 pounds (Table XII).

Second, and more important, this table allows too much weight at the shorter heights. Allen et al.[33] reporting body composition measurements in a group of twenty-one Chinese men on Formosa between fifteen and twenty-five years of age, found they averaged 64 inches in height, and 115 pounds in weight. The per cent standard weight was 90.5. The mean body fatty tissue by densitometry was 21 per cent of body weight. This is comparable to the 21 to 30 per cent fatty tissue of American troops. From a formula derived by Allen and his co-workers[34] which predicts per cent fatty tissue from height and weight, the per cent body fatty tissue in a twenty-year old man of exact standard weight (Actuarial tables) varies from 30 per cent at a height of 60 inches to 25 per cent at 65 inches, to 21 per cent at 70 inches. It seems more reasonable for the per cent of body weight to remain constant at each height. That the Filipino soldiers are remarkably comparable to the Chinese group in height and weight[35] is evident from Figures 4 and 5. Allen's formula predicts that average body fatty tissue constitutes 24.6 per cent of the weight of the Filipino soldiers, based on the over-all average height and weight.

It is of interest to compare the average weight for height data compiled in this survey with that recorded by Cordero et al.[36] who compiled height-weight-age data on 12,000 Filipino men and 7,000 Filipino women. Table XXXVII compares his data with standards used by a Filipino insurance company, with American standards (of ideal weight) developed by the Metropolitan Life Insurance Company, and with data reported in this study. The Filipino troops apparently fall somewhat short of Cordero's civilian data. The most likely explanation here is that his measurements were made in ordinary light clothing without shoes whereas the data obtained in this study were on individuals clad only in their undershorts. It is estimated that this would introduce a minimum difference of 2 pounds in the averages. Correcting the data for the Armed Forces of the Philippines by this amount brings them into close agreement with both the data of Cordero and the Philippine insurance company standards. On the other hand, the average Filipino man in this age range is 9 per cent lighter than an American of medium build and 3 per cent lighter than an American of light build. Con-

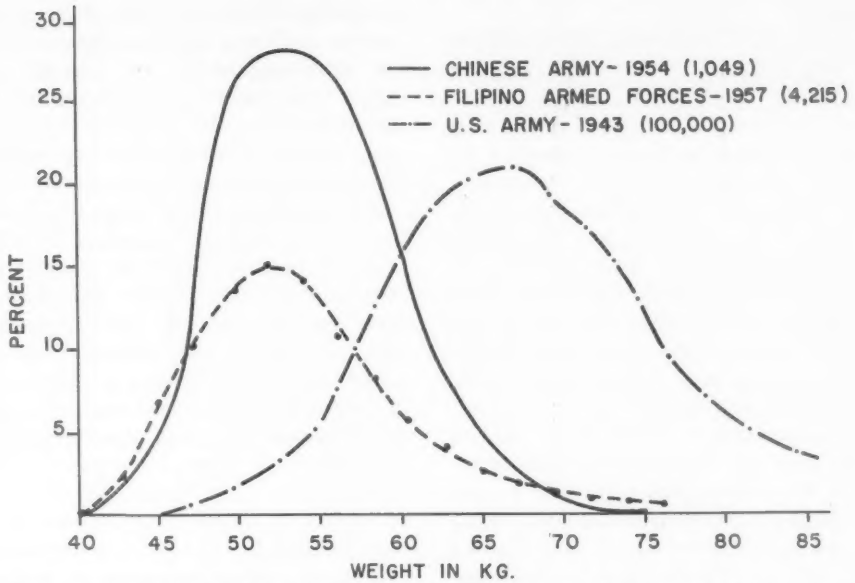

FIG. 4. Comparison of weight distributions in the Filipino Armed Forces, in the Chinese Army and in U. S. Army inductees.

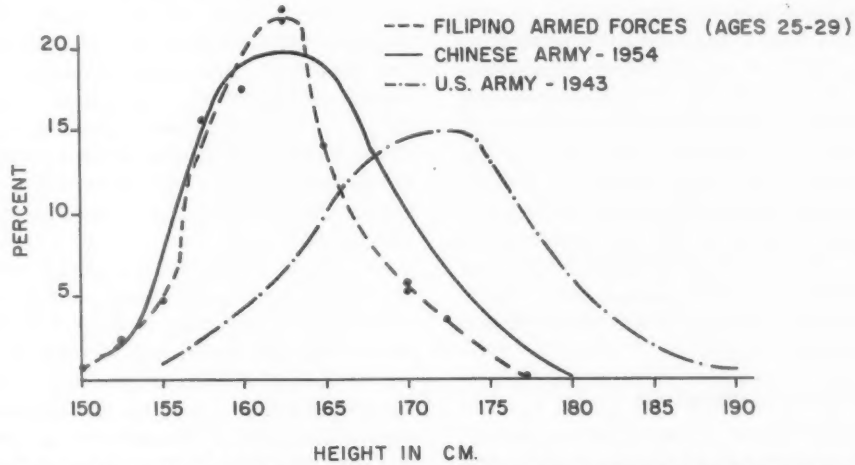

FIG. 5. Comparison of height distribution in the Filipino Armed Forces, in the Chinese Army and in U. S. Army inductees.

siderations of body composition do not indicate that this reflects caloric underfeeding.

The skinfold thickness of both the arms and scapula increased slightly with age (Fig. 2A) and more significantly with increasing per cent of standard weight (Fig. 2B). By applying the formula of Allen et al.,[34] one can calculate per cent of body fat from skinfold thickness. Although Allen and co-workers measured ten skinfold sites on each subject, the sum of the two folds measured in the Philippine study multiplied by 5 and used in Allen's formula predicts a mean body fatty tissue content of 22.9 per cent. This checks reasonably well with the 24.6 per cent of body fat predicted from the average heights and weights.

Caloric Intake

When the caloric intakes are calculated per unit of body weight they are satisfactory for moderate work. Recent data on the caloric intakes of U. S. troops at different levels of work in different climates have been presented by Welch and co-workers.[38] In the temperate zone the intakes are 60 calories per kg. for heavy work (basic training), and 49 calories per kg. for moderate work. A tropical environment decreases the consumption about 2 calories per kg., to 58 and 47 calories per kg., respectively. Troops eating at two of the Philippine Army messes were doing heavy work. The intake (chemical analysis) at these messes averaged 3,026 calories. Food intake outside the mess averaged 33 calories. This total caloric intake, 3,059 calories, divided by the average weight of the men examined, gives 57.1 calories/kg. The men at the other messes surveyed were mostly engaged in moderate work. The caloric intake at these seven messes was 2,419 calories, to which should be added 224 calories for food consumed outside the mess (average of four calculations). The total intake was therefore 2,643 calories. This intake provides 46.1 calories/kg. at the average body weight of the men examined at these seven locations. These calculations show good agreement between the caloric intakes of Filipino and American soldiers performing similar work.

These considerations lead to the conclusion that the caloric nutriture of those examined is probably adequate. The almost total absence of gross obesity indicates a less than extravagant intake of calories.

Protein, Fat and Carbohydrate

Dietary protein intake was good in quantity. A large part of the protein was supplied by rice. On physical examination there was no evidence of protein deficiency, although about 10 per cent of men examined had total serum protein levels of less than 6.0 gm. per 100 ml. The blood protein levels deserve further investigation. It is unfortunate that fractionations were not made on these. The Air Force men had a higher incidence of low serum protein levels than other groups, and the mess survey of the Air Force base recorded the lowest protein intake. Although these data are insufficient to support a finding of deficiency in protein, they suggest that the protein nutriture should be reviewed periodically in order to insure maintenance of adequacy. In so doing, caloric intake *per se* as well as the calorie-protein consumption must be assessed.

Fat intakes were low, constituting between 10 and 15 per cent of total calories. In relation to this it may be noted that the mean serum cholesterol was 171 mg. per 100 ml., which is lower, but not strikingly so, than the average value of 198 mg. per 100 ml. found among Americans consuming 40 per cent of dietary calories as fat.[39] The carbohydrate content of the Filipino diet was high, being largely derived from rice.

Minerals

As indicated in the section on dietary appraisal, the calculated intake of calcium was "low," but chemical analysis indicated a good intake. No clinical suggestion of osteomalacia was evident. The calculated daily average intake of 388 mg. is borderline between acceptable and "low"; the average intake of 1,054 mg. as estimated from analysis of aliquots is high. More credence should probably be given to the latter figure despite present inability to identify the source of extra calcium. It is concluded that the dietary intake of calcium is adequate.

The intake of iron, even the lower value obtained by calculation, was adequate for normal men. This supposition is supported by the low incidence of "deficient" (less than 12.0 gm. per 100 ml.) blood hemoglobin values. Hookworm infestation was relatively common and would be expected to increase the requirement for iron. However, the majority of these infestations were light, and probably did not appreciably affect the hemoglobin levels. The observed dietary intake of iron should be considered satisfactory.

Vitamin A and Carotene

Despite an average estimated intake of vitamin A of but some 2,400 I.U. per day, there was no clinical evidence of vitamin A deficiency. Indeed, the blood levels of vitamin

A were high. There was no correlation between clinical follicular keratosis and "low" serum vitamin A levels, and ocular lesions attributable to avitaminosis A were notably absent. Although dietary carotene was not determined, the low serum levels which were seen in most areas indicated a moderate or low intake of carotene-rich foodstuffs. The good levels of vitamin A in the serum support the conclusion that liver stores of vitamin A were adequate despite the less than abundant intake. One is led to conclude that the consumption of vitamin A-active substances has been more satisfactory in the past and that the "low" serum carotene levels indicate that recent intake of provitamin A was low. It may be significant that the survey was conducted during the dry season in the Philippines when carotene-rich vegetables and fruits are less available than at other seasons of the year, and these results probably reflect the seasonal decrease in carotene supply.

TABLE XXXVIII

Guide to Interpretation of Nutrient Intake Data*

Nutrient	Deficient	Low	Acceptable	High
Niacin (mg./day)	<5	5–9	10–15	>15
Riboflavin (mg./day)	<0.7	0.7–1.1	1.2–1.5	>1.5
Thiamine (mg./1,000 cal.)	<0.2	0.20–0.29	0.3–0.5	>0.5
Ascorbic acid (mg./day)	<10	10–29	30–50	>50
Vitamin A (I.U./day)	<2,000	2,000–3,499	3,500–5,000	>5,000
Calcium (gm./day)	<0.3	0.30–0.39	0.4–0.8	>0.8
Iron (mg./day)	<6.0	6–8	9–12	>12
Protein (gm./kg.)	<0.5	0.5–0.9	1.0–1.5	>1.5
Calories	...	...	...	...

* ICNND Manual, page 123.[19]

Thiamine

As in most regions where the staple food is polished rice, the thiamine intake was "low." Although a rice enrichment law is in effect, only a small part of the rice purchased by military messes had been enriched. Of the men examined, 13.5 per cent exhibited urinary thiamine levels in the "deficient" range. Those men in whom ankle jerks were missing excreted thiamine at the same rate as did the total sample. There was, however, an unusually high incidence of neurologic changes which might be attributable to chronic lack of thiamine. No beriberi was seen among troops or in hospitals visited. The clinical findings were consistent with a "low" intake level but one above that of gross thiamine deficiency.

The average thiamine intake was 1.01 mg. in a population averaging 57.4 kg. in weight. This corresponds to an intake of 1.25 mg. in a population of 70 kg. average weight. Appraisal of this intake from the standpoint of thiamine-calorie ratio based on the figures from clinical analysis of composites makes it evident that at two of nine locations the intakes were below 0.2 mg. per 1,000 calories ("deficient"), and at one it was 0.21 mg. per 1,000 calories. For diets of such high carbohydrate composition, this is not an adequate dietary supply of thiamine. Despite the meager clinical evidence of deficiency, these considerations indicate that the intake of thiamine provides no factor of safety. This appraisal of intake is supported by the relatively high percentage of subjects who exhibited "deficient" or "low" urinary excretion of thiamine. There is clear need for measures to increase the thiamine supply.

Riboflavin

The intake of riboflavin was low, averaging 0.75 mg. per day. This is barely above the "deficient" level (0.7 mg. daily) in the suggested guide to interpretation of nutrient intake data (Table XXXVIII). Clinical evidence of riboflavin deficiency was equivocal. Definite signs of active deficiency such as cheilosis, angular lesions of the mouth, magenta tongue and scrotal dermatitis were present in a small fraction of the men examined. Many angular scars were seen, but few of these scars were of major proportions. Such scars may indicate previous riboflavin deficiency but cannot be taken as evidence for existing deficiency. Nasolabial seborrhea occurred in a large proportion of the men. This lesion is not pathognomonic of riboflavin deficiency. Indeed, there was little clinical support for the existence of active ariboflavinosis.

The urinary riboflavin excretions were in the

range considered good, which tends to discount the significance of the minor clinical findings. Another possibility must be considered here; in rats chronic thiamine deficiency tends to increase the urinary excretion of riboflavin. The thiamine intake of the Filipino troops was somewhat low. If the data from experimental animals apply to man, the observed urinary riboflavin excretions may have been disproportionately high.

It is of interest to compare the findings of the present survey with those on the Nationalist Chinese Army on Formosa.[40] The dietary riboflavin intake and rate of excretion on Formosa were similar to those observed in the Philippines. The wide divergence in incidence of clinical signs has no obvious explanation. No statistical correlation exists between the various lesions thought to be indicative of riboflavin deficiency and the excretion of riboflavin in the urine. It seems reasonable to conclude that the examinees have somehow compensated for or adjusted to the rather low intake of riboflavin in the Philippines to the extent that the level of intake does not cause an appreciable problem. Nevertheless, it is lower than desirable.

Niacin

The average dietary intake of niacin as estimated by all measures was in the high range (more than 15 mg. daily) in practically every instance. In the few exceptions, the intake was in the acceptable range. There was no evidence of pellagra, and the urinary excretion of N′-methylnicotinamide was good. Although a considerable amount of corn is grown in the southern islands, even there rice remains the basic staple food. There was no correlation between the clinical finding of thickened pressure points and urinary N′-methylnicotinamide. Clearly, niacin nutriture was excellent.

Ascorbic Acid

The dietary intake of ascorbic acid varied considerably from mess to mess. The average daily intake of 43 mg. is in the upper portion of the range judged acceptable (30 to 50 mg. daily). In two of nine messes surveyed the intake was below 20 mg. and in the range appraised as "low" (10 to 20 mg.). "Deficient" or "low" levels of ascorbic acid in the serum occurred in some 50 per cent of the Air Force personnel, and in 12 and 17 per cent of the Constabulary and Army, respectively. The findings indicate an inadequate intake of ascorbic acid-containing foods by an appreciable portion of the troops. The mean serum ascorbic acid of the few men who had bleeding gums and scorbutic-type lesions of the gums was significantly lower than the average level, although the incidence of clinical signs suggestive of vitamin C deficiency was low. The few men with clinical evidence of ascorbic acid deficiency were concentrated in the group of recent inductees with less than three months military service. These results indicate that the diet of the Armed Forces of the Philippines contains more ascorbic acid than at least some of the civilian diets, but that there is a need (except in the Navy) to increase the intake of foods containing appreciable amounts of ascorbic acid by a sizable portion of the Armed Forces, especially the Air Force.

Parasites

Although considerable percentages of the men harbored intestinal parasites, especially trichuris, hookworm and ascaris, in that order of frequency, the majority of infestations was light. It is doubtful whether these infestations have appreciable clinical significance, particularly in relation to nutrition.

Serum Cholesterol

These findings are discussed at some length in the accompanying paper.[29]

Nutrition in General

Although from clinical examination the nutritional state of the members of the Armed Forces of the Philippines is judged as good, dietary and biochemical evidence indicates that the intake of thiamine, riboflavin and ascorbic acid was low. The intake of these vitamins is sufficient to prevent widespread gross clinical avitaminoses. However, any situation which compromised or disrupted

present food supply or enhanced activity, such as general hostilities, would likely result in the appearance of avitaminoses unless active preventive measures are instituted.

It has, of course, been recognized for some time in the Philippines that intake of these vitamins is inadequate, and a program of rice enrichment with thiamine has been undertaken. This program has not been generally adopted. Enriched rice is not available for purchase by most military installations. For the Armed Forces, the problem of providing enriched rice might be solved if central purchasing and distribution of enriched rice were feasible. However, this appears impracticable because it would require a tremendous increase in quartermaster facilities and in transportation, and also would not readily obtain for the 40 per cent of personnel who eat outside messes with their families and who purchase their food locally. Unless effective universal rice enrichment in the Philippines is established, it is difficult to see how the benefits of enriched rice can be made available to the Armed Forces throughout the country.

Another possible means of supplementation is through the use of vitamin capsules or enrichment wafers. These might be given to the men daily or once or twice a week, in a manner similar to the regimen for suppression of malaria. However, such a program would be expensive and difficult to administer, and would not affect the intake of some of the other nutrients (protein, carotene), an increase in which could be looked on with favor.

General improvement of the diet is needed. An increase in the consumption of fresh fruit and meat would enhance the intake of riboflavin, thiamine and ascorbic acid to acceptable levels. An increase in the monetary allowance for food is necessary to make this possible. The present allowance of 1 peso per man per day has been in effect without change since 1949, although food prices have steadily increased since that time. A factual review of the basis for the ration allowance is most desirable. This could be done, perhaps with the aid of the Institute of Nutrition in Manila, by developing a series of nutritionally adequate menus, determining the average cost of the food, and setting the ration allowance at the resulting figure.

Such a revised allowance should provide for adjustment in high or low cost areas throughout the islands—an adjustment which is not made at present. For example, fish were inexpensive in Jolo compared to other places. Vegetables were scarce and expensive in some areas but plentiful in others. Fruits, except for bananas, were usually too expensive to be purchased within the ration allowance. These observations point to the need for development of an elastic formula based on nutritional needs which will permit adjustment in the monetary allowance per ration from time to time and place to place. For units which are stationed close together, the issue of food in kind from a central commissary could automatically adjust for price changes. Also, establishment of central commissaries to supply messes where practicable would relieve the mess personnel of the burdensome task of accounting for the cash allowance. Many man hours in each mess are at present being used to maintain adequate records of financial accountability. The issuance of food in kind through a central commissary, at least in the Manila area, would free responsible personnel to spend more time supervising food preparation and serving.

The distribution and location of many small units of the Armed Forces make it impractical to issue food to all organizations. For units which must use cash to make local food purchases, a "garrison" ration system as formerly used by the U. S. Army could be established. In this system the monetary ration allowance is established by applying current prices to a standard list of food items. A daily amount of each food is specified and the total cost of all items becomes the monetary ration allowance for use in the next ration period. The list of foods to be used would have to be those commonly available at all military locations. The actual items used should be worked out by the Armed Forces of the Philippines in consultation with various food and nutrition experts in the Islands. The principle, however, can be illustrated as follows with some assumed prices:

Food	Weight of Food Item per Day (lb.)	Cost per Pound (pesos)	Total Daily Cost (pesos)
Rice	1.25	0.20	0.25
Fish	0.50	0.70	0.35
Beef	0.10	1.00	0.10
Pork	0.15	1.00	0.15
Bread	0.20	0.25	0.05
Petsay	0.25	0.25	0.12
Bananas	0.15	0.20	0.03
Lard	0.05	0.50	0.03

The foods used in this formula should include items representing the six basic food groups as specified by the Philippine Institute of Nutrition. The quantity specified is not intended to be the amount of each food which should be consumed. Since the list does not include all items purchased by a mess, the quantities must be somewhat larger than typical consumption figures. Calculation of the monetary value of the ration could be made for periods of three to six months for each military area and the value of the ration made known to all units in that area. Properly trained mess personnel could then make the translation of listed items into other equivalents obtainable from local markets.

Mess Practice

Food preparation practices were observed to be less than ideal in many locations. In general, cooking practices reflected a lack of training and experience of the cooks. It was common to observe prolonged overcooking of foods with consequent loss of nutrients. This prolonged cooking was often simply due to preparation too far in advance of serving time. Mess personnel frequently asked for assistance in obtaining menu guides and recipes. Few units had a recipe guide available. Even though a recipe guide book has been published by the Philippine Quartermaster General it was not usually available in the messes observed.

The need for the organized training of mess and dietary personnel within the Armed Forces of the Philippines was apparent. As indicated, mess personnel often recognized their limitations and were most eager for advice, recipes and menu plans. There was no standardization of equipment and a lack of clear appreciation of elementary principles of food sanitation was widespread. It is highly desirable to organize a mess personnel training course in which men would be trained for the operation of the several levels of mess responsibilities. During the training period the personnel should be taught principles of food sanitation, food procurement and the planning of menus. In addition, personnel should be instructed in the use of recipes and of nutritionally equivalent substitutes. The recipes used should most logically be developed by the school in conjunction with the staff of the Institute of Nutrition in Manila.

The Armed Forces of the Philippines have done some work on the development of combat rations, but at present no satisfactory packaged ration exists because of the poor keeping qualities and the high cost per ration. Operational rations in use were based on local purchases by the unit or direct cash purchases by the individual soldier. Fresh items were carried for two days, then dry rice and canned items were used. The Quartermaster School, Armed Forces of the Philippines, prepared a report in 1956 on a study of field rations. In this area it appears that a joint investigation by the Preventive Medicine Branch, the Quartermaster Corps and the Institute of Nutrition could be profitable and productive.

Finally, a word should be said concerning the role of the hospital dietitians in the hospitals and nutrition unit of the Armed Forces of the Philippines. Although most of the hospitals are too small to warrant the services of a full-time dietitian, it would be useful to the mess personnel of the hospitals if some guidance were available concerning the preparation of food for hospital patients. A consulting dietitian should be related not only to the hospital dietary work and the planning and preparation of food for hospital patients, but also to the suggested training program for mess personnel and the cooperative development of menus, recipes, etc., to be used in the field. Clearly, the individual with these responsibilities should have a strong dietetic background and should be afforded the opportunity of keeping abreast of modern dietetic practice and theory through participation in postgraduate training seminars

and other professional training experiences. The Republic of the Philippines is fortunate in having a considerable resource of well trained dietitians whose abilities, unfortunately, are not adequately utilized at present.

CONCLUSIONS

The military personnel of the Philippines have a low intake of thiamine, riboflavin and ascorbic acid. This intake would be improved by increased consumption of leafy green vegetables, yellow vegetables, fresh fruits, meats, fish, soybeans and other legumes. The general use of enriched rice would substantially increase the intake of thiamine. Among the means that might be employed to bring about such nutritional improvement for the military population, the following points are worthy of consideration:

1. Establishment of a Central Nutrition Service for the Armed Forces of the Philippines in the Preventive Medicine Branch of the Surgeon General's Office. Among its personnel should be physicians, quartermaster officers, dietitians and food research and development personnel. This Nutrition Service should make full use of existing Filipino resources in the field of nutrition, particularly the Institute of Nutrition, the trained dietitians in the country, and consultation with international and bilateral agencies such as WHO, FAO, ICA and JUSMAG missions in the country.

2. Revision of the monetary ration allowance, based on the cost of a nutritionally adequate diet. Such an allowance should permit adjustments for variations in the cost of food from season to season and location to location, and be reviewed and adjusted from year to year.

3. Development of basic menu and recipe guides for use in the Armed Forces. To insure adequate intake of all nutrients, menu guides should provide satisfactory food exchanges or substitutes based on the six basic food groups as classified by the Institute of Nutrition, allowing for seasonal and area availability of food. Recipe guides should take into account food losses due to waste and cooking.

4. Establishment of supply points at convenient locations throughout the islands for procurement and distribution of food staples, such as rice, to be issued to individual units for use in the messes and for distribution to men on cash rations. A reduced monetary allowance could then be paid to units and individuals to cover local purchase of perishable food items, and isolated units that cannot be so supplied would receive the full monetary allowance.

5. Initiation in selected areas of central purchase of both staple and perishable foods and issuance of rations in kind according to a master menu. This would of necessity be limited to areas where several messes are located within reasonable supply distances.

6. Enrichment with added thiamine of all white rice provided to the troops through these supply points. This could be most effectively accomplished if controlled rice enrichment were to become universal in the country.

7. Development of training schools for mess and dietary personnel, teaching principles of menu planning, food procurement, preparation, cooking and sanitation.

8. Provision of military kitchens of at least a minimum of standardized equipment to permit adequate and sanitary operation.

9. Further study and development of combat rations based on indigenous foods on the part of the Central Nutrition Service.

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Serum Total Cholesterol Values in Men of the Armed Forces of the Philippines

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PRIOR to March 1957 when a team of the Interdepartmental Committee on Nutrition for National Defense of the United States started a nutrition survey of the Armed Forces of the Philippines, there were no published studies on serum cholesterol levels of Philippine subjects. The opportunity to carry out such a study in conjunction with the nutrition survey was therefore welcomed in view of the current interest in comparative studies of serum total cholesterol levels among different populations of the world, such as those of Keys and co-workers on Americans,[1] Italians[2] and Spaniards[3] and of Bronte-Stewart et al. on different racial groups in Cape Town, South Africa.[4]

The dietary data afforded an opportunity to examine some of the factors that have been implicated as having an influence on serum total cholesterol levels. This report includes data on the total calories, the percentage of the dietary calories supplied by fat and the extent to which the fat is supplied from animal and vegetable sources.

Statistical analysis was performed to test the probability of any correlation existing between serum total cholesterol values and each of the following: age, systolic and diastolic blood pressure, relative body weight, serum vitamin A and carotene and hemoglobin levels.

MATERIAL AND METHODS

The methods used in the selection of subjects from the Philippine Army, Navy, Air Force and Constabulary, the withdrawal and analysis of blood samples for various nutrients and the dietary survey are given in the report of the survey team of the Interdepartmental Committee on Nutrition for National Defense.[5]

The serum total cholesterol was determined on duplicates by the method of Abell et al.[6]

RESULTS

The 403 subjects of this study were classified into two groups: 351 randomly selected subjects and a non-random group of fifty-two persons selected by the survey team for special biochemical studies.[5] The frequency distributions of the serum total cholesterol values of the two groups are shown in Table I. The range, mean, standard deviation and standard error of each group are included in this table.

The mean values obtained in the two groups are comparable to those of populations that are considered to have relatively low serum cholesterol levels, such as the Neapolitans[2] and the Bantus.[4]

Dietary Aspects that Have Been Claimed to Influence Serum Cholesterol Levels

Of the dietary factors that have been studied in relation to serum cholesterol levels of different populations, the percentage contribution of fats to the total calories, the kind of fat, whether of animal or vegetable origin and finally the degree of unsaturation of the fatty acids in the individual fats of the diet have received the most attention.

From the aforementioned surveys of different populations and from other studies,[7] Keys[8] has deduced that in areas where the fat intake constitutes 20 per cent or less of the

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TABLE I

Frequency Distributions of Serum Total Cholesterol Values in Random and Non-Random Subjects from the Armed Forces of the Philippines

Serum Cholesterol (mg. %)	Random Group		Non-Random Group	
	No. of Subjects	Percentage of Total	No. of Subjects	Percentage of Total
<100	3	0.9	1	1.9
100–119	17	4.8	0	0
120–139	45	12.8	8	15.4
140–159	73	20.8	7	13.5
160–179	75	21.4	10	19.3
180–199	79	22.5	13	25.0
200–219	32	9.1	6	11.5
220–239	17	4.8	4	7.7
240–259	7	2.0	1	1.9
>259	3	0.9	2	3.8
Total	351	100	52	100
Mean	169.7		180.4	
Range	73–274 mg. %		93–353 mg. %	
Standard deviation	33.5		43.2	
Standard error of the mean	2.7		6.0	

total calories of the diet, the serum cholesterol values are significantly lower, especially in subjects over forty years old, than in areas such as northern Europe and the United States where fat supplies 40 per cent or more of the total calories.

The observations relating serum total cholesterol levels to the quantity of fat intake have been supplemented with carefully controlled experiments on human subjects which have demonstrated that reduction of the proportion of fat in the diet resulted in significant lowering of the serum total cholesterol.[9] Studies have also shown that the cholesterol content of the diet *per se* exerts no significant effect on serum total cholesterol.[10]

On the other hand, several reports indicate the importance of kind or origin of the fat in the diet on serum cholesterol levels. Among these is the report of Kinsell et al.[11] that the ingestion of synthetic diets containing large amounts of vegetable fats lower the serum cholesterol in man. Other workers confirmed this finding.[12] Ahrens et al.[13] found that the serum cholesterol level was reduced by 20 to 30 per cent by the use of diets with a high vegetable fat content (70 per cent of total calories).

Subsequent experiments on man, in which adequate diets containing only one fat were given for periods of not less than four months to test the effect on serum cholesterol of individual fats,[14] have shown that the results are best correlated with the mean degree of unsaturation of the fat as measured by its iodine value. It is the fatty acid composition of the ingested fat that is now presumed to determine its effect on serum cholesterol level. As Keys[15] has pointed out, however, the fats most favored and abundant in diets with a high fat content are those which promote hypercholesteremia rather than those with the opposite effect.

The dietary study of twenty-two mess halls of the Armed Forces of the Philippines and of twenty-eight persons who took their meals in their homes yielded the data summarized in Table II. The figures presented for mess halls are averages of all results whenever two or more methods of study were used in the same camp. Calories from fat were computed for each food item using the data given in the U. S. Department of Agriculture Handbook No. 34

TABLE II

Average Total Calories per Capita per Day, and Percentage of Total Dietary Calories Supplied by Fat (Animal and Vegetable) in the Average Diets Served in Twenty-Two Mess Halls and Twenty-Eight Homes of Enlisted Men in the Armed Forces of the Philippines

Dietary Statistic	Mess Halls*	Homes
Average total calories per capita per day	3,068	2,650
Standard deviation	677	530
Animal fat:		
Mean (%)	7.7	8.8
Range of percentage contribution to total calories	1.1–15.5	0.4–21.2
Vegetable fat:		
Mean (%)	6.3	8.1
Range of percentage contribution to total calories	1.6–13.7	1.5–15.7
Total fat:		
Mean	13.9	16.9
Range of percentage contribution to total calories	5.1–24.5	2.8–33.6

* Average of results by all methods in any mess.

for different fats. Only in the chemical analysis was the general factor of 9 calories per gm. of fat used since the samples were mixtures of all items of food in the day's meals.

The mean percentage of total calories supplied by fat shows that the diet of the Armed Forces of the Philippines has a relatively low fat content if judged according to figures given by Keys[15] for different populations. This may explain partly the relatively low levels of serum cholesterol obtained in this study.

The mean values also showed that vegetable and animal fat contributed almost equally with only a slight excess of animal over vegetable fat at the mess halls. However, there was a great deal of variation (Table II). The vegetable fat was mostly in the form of shortening derived from coconut oil. The animal fat was mainly from pork and beef. Very little fat was contributed by milk and dairy products.

It is of interest that Ahrens and co-workers[14] found coconut oil (a relatively saturated fat) one of the dietary fats that produce the highest serum cholesterol levels when given as the sole fat in the diet of human subjects. Its effect is more pronounced than fat from beef. The common use of cooking oils derived from coconut oil in Philippine dietaries, however, has not produced high serum cholesterol levels in the subjects of this study.

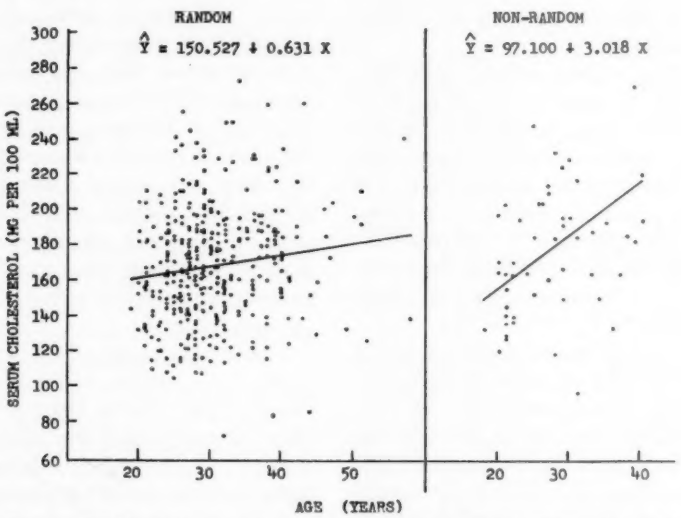

FIG. 1. Relation between serum cholesterol level and age in 351 random and fifty-two non-random subjects from the Armed Forces of the Philippines. Note: One point (40, 353) in the non-random group was omitted in the graph but not in the calculation for the regression line.

TABLE III

Regression Coefficients of Serum Total Cholesterol on Age, Systolic and Diastolic Blood Pressure, Relative Body Weight, Serum Vitamin A, Serum Carotene and Hemoglobin Level; Standard Error of the Regression Coefficients, and Corresponding T Values—Random and Non-Random Subjects, Armed Forces of the Philippines

Physical or Biochemical Variable	No. of Subjects	Slope of fitted line b	Standard Error S_b	$t = \frac{b}{S_b}$
		Random Group		
Age	351	0.631 mg. % per year of age	0.263	2.399*
Systolic blood pressure	351	0.236 mg. % per mm. Hg	0.125	1.888
Diastolic blood pressure	351	0.498 mg. % per mm. Hg	0.194	2.567*
Relative body weight	349	0.530 mg. % per 1% standard weight	0.177	2.994†
Serum vitamin A	348	−0.099 mg. % per μg. %	0.137	0.723
Serum carotene	348	0.345 mg. % per μg. %	0.048	7.188†
Hemoglobin	346	0.101 mg. % per gm. %	1.339	0.754
		Non-Random Group		
Age	52	3.018 mg. % per year of age	0.862	3.501†
Systolic blood pressure	52	0.154 mg. % per mm. Hg	0.424	0.363
Diastolic blood pressure	52	1.336 mg. % per mm. Hg	0.588	2.272*
Relative body weight	52	1.405 mg. % per 1% standard weight	0.652	2.154*
Serum vitamin A	52	−0.561 mg. % per μg. %	0.448	1.252
Serum carotene	52	0.623 mg. % per μg. %	0.076	8.197†
Hemoglobin	51	1.236 mg. % per gm. %	4.332	0.285

* Significant at the 5% level.
† Significant at the 1% level.

The Relation of Serum Total Cholesterol to Some Physical and Biochemical Variables

The results of the statistical analysis of the relation of serum total cholesterol values to age, systolic and diastolic blood pressure, relative body weight, serum vitamin A and carotene, and hemoglobin levels are summarized in Table III.

Age: Our study showed that in the random group, there was a rise of 0.63 mg. per 100 ml. of serum cholesterol per year increase in age between the ages of nineteen to fifty-eight years. This rise is significant at the 5 per cent level. In the non-random group, a much greater rise, 3.02 mg. per 100 ml. per year between eighteen and forty years of age, (significant at the 1 per cent level) was obtained. That there was a preponderance of subjects in the lower age levels in this study is shown by the mean of 30.4 years for the random group and 27.6 years for the non-random group. Figure 1 shows the distribution of the individual cholesterol values according to age and the fitted line by the method of least squares.

A similar trend has been noted previously in other population groups by Keys and co-workers. In their studies on male Neapolitans[2] and Spaniards[3] they reported a progressive increase in serum total cholesterol from age eighteen to thirty-four years, but no significant change from thirty-five to fifty years of age. In contrast to this finding in the middle-aged group, male American subjects in Minnesota[1,24] showed a significant continued increase in this age bracket averaging 40 mg. per 100 ml. from age thirty-five to fifty years.

In the two groups in our study, it was not possible to determine if a significant difference in the trend exists at the older age range because of large individual variations and the small number of subjects over forty years of age.

Blood Pressure: No correlation was found

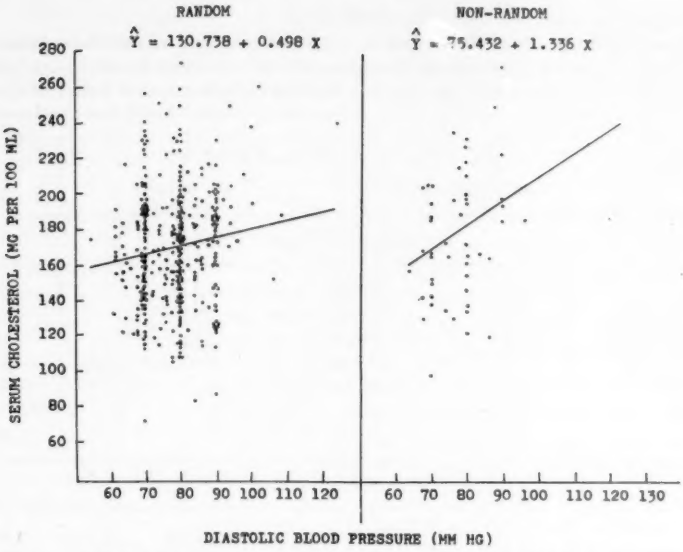

FIG. 2. Relation between serum cholesterol level and diastolic blood pressure in 351 random and fifty-two non-random subjects from the Armed Forces of the Philippines. Note: One point (88, 353) in the non-random group was omitted in the graph but not in the calculation for the regression line.

between serum total cholesterol and systolic blood pressure in the random and non-random groups in this series. There were thirty-one men in the random group and two men in the non-random group whose systolic blood pressure was over 140 mm. Hg. Their mean serum cholesterol values did not differ significantly from those of men in their respective groups whose systolic blood pressure readings were 140 mm. Hg or below.

Malmros et al.[16] reported a similar lack of correlation between serum cholesterol and systolic blood pressure among Neapolitan and Swedish subjects from twenty to fifty-nine years old. Our subjects belong to the same age range as theirs.

Increase in serum total cholesterol with rise in diastolic blood pressure of the order of 0.498 mg. per 100 ml. and 0.588 mg. per 100 ml. per mm. Hg in the random and non-random groups, respectively, were found to be significant at the 5 per cent level. Figure 2 shows the relation of serum cholesterol and diastolic blood pressure. The regression line was determined by the method of least squares.

In older subjects (sixth to eighth decade), Hobson and associates[17] and Gillum et al.[18] reported no such correlation.

There were fourteen men in the random group whose diastolic blood pressure readings were over 90 mm. Hg. They had a mean serum cholesterol level of 204.2 mg. per 100 ml. ± 8.60 (S. E.), which is 35.9 mg. per 100 ml. higher than the mean (168.3 ± 1.79) of the 337 men with diastolic blood pressure readings of 90 mm. Hg or below. This difference is statistically significant at the 1 per cent level. No such difference was found in the non-random group in which only two men exhibited diastolic blood pressure readings of over 90 mm. Hg.

Relative Body Weight: In the examination of the relation between the serum cholesterol level and relative body weight, the latter was obtained as the per cent of standard body weight as given in the Manual for Nutrition Surveys of the Interdepartmental Committee on Nutrition for National Defense.[19a] Our results showed a rise of 0.53 mg. per 100 ml. per 1 per cent increase of relative body weight (significant at the 1 per cent level) in the random group, and 1.405 mg. per 100 ml. per 1

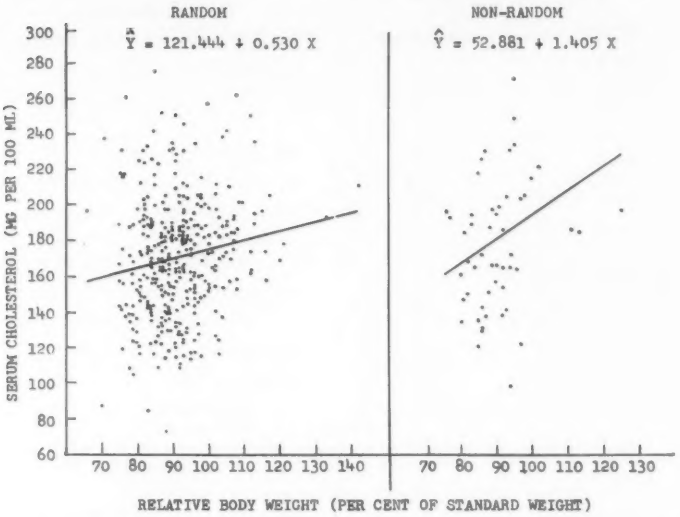

FIG. 3. Relation of serum cholesterol level to relative body weight expressed as per cent of standard weight in 349 random and fifty-two non-random subjects from the Armed Forces of the Philippines. Note: One point (102, 353) in the non-random group was omitted in the graph but not in the calculation for the regression line.

per cent increase in relative body weight (significant at the 5 per cent level) in the non-random group. Figure 3 shows the scatter diagram and the best fitted line of this relationship by the method of least squares.

These findings are comparable to those of Sandstead et al.[19b] on Navajo Indians in whom higher values of serum cholesterol were obtained in the heavier groups.

In the random group of this study, 162 men whose body weights were less than 90 per cent of the standard weight had a mean serum cholesterol of 165.5 mg. per 100 ml. The 172 men who weighed from 90 to 110 per cent of the standard weight had a mean serum cholesterol of 172.3 mg. per 100 ml. The difference between the means of the two groups is not significant. However, between the fifteen men whose body weights were more than 110 per cent of the standard weight (and whose mean serum cholesterol was 190.1 mg. per 100 ml.) and the men who weighed between 90 to 110 per cent of the standard weight, there was a difference between means of 17.8 mg. of cholesterol per 100 ml. of serum. This is significant at the 5 per cent level.

No significant differences were found between the corresponding groups of the non-random subjects, only three members of which had body weights over 110 per cent of the standard weight.

Serum Vitamin A and Carotene Levels: Our results (Table III) show no correlation between serum cholesterol and serum vitamin A levels. In contrast to this finding, increases in serum cholesterol of 0.345 mg. per 100 ml. were found in the random group and 0.623 mg. per 100 ml. in the non-random group per microgram per cent increase in serum carotene level. Both of these increments are significant at the 1 per cent level. Figure 4 shows the scatter of the serum cholesterol values in relation to serum carotene levels with the regression line computed by the method of least squares.

The relationship of vitamin A to cholesterol metabolism has not yet been completely elucidated. Green et al.[20] reviewed the conflicting results of previous work on the effect of deficiency of vitamin A on plasma cholesterol of animals, and reinvestigated the changes in plasma and liver cholesterol of rats with vitamin A deficiency on the possibility that steroid

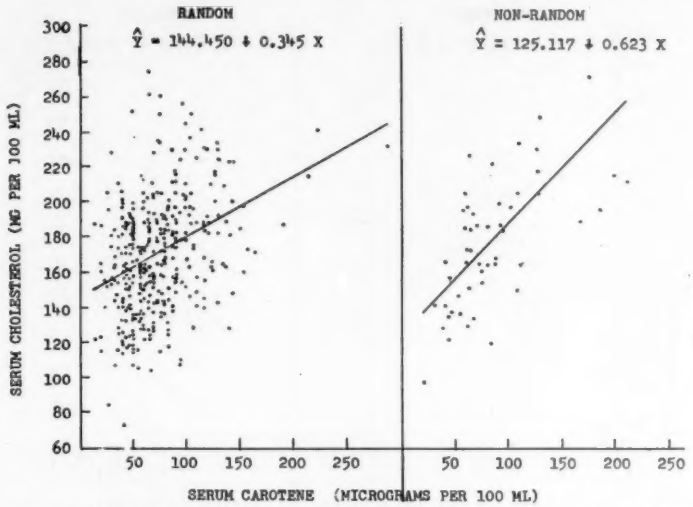

FIG. 4. Relation between serum cholesterol level and serum carotene in 348 random and fifty-two non-random subjects from the Armed Forces of the Philippines. Note: One point (303, 353) in the non-random group was omitted in the graph but not in the calculation for the regression line.

metabolism in general may be affected by deficiency of vitamin A. They found no significant changes in cholesterol levels in either the deficient or non-deficient animals, and concluded that in a quantitative sense, cholesterol metabolism is not responsive to depletion of vitamin A. This conclusion is supported by Wolf et al.[21] who demonstrated by isotopic studies a lack of involvement of vitamin A in cholesterol biosynthesis in the intact rat. The lack of association between serum cholesterol and serum vitamin A levels in our study is in accord with these findings.

The significant correlation between serum total cholesterol and serum carotene levels in our study corroborates the findings of Stockwell et al.[22] in the Navajo Indian. These authors cite other studies in which such an association had been noted previously and attribute this finding to a similarity of transport mechanisms for these two substances.

Hemoglobin Levels: As shown in Table III, no correlation was found between serum cholesterol and hemoglobin levels in this series.

Low concentrations of plasma cholesterol have been reported in certain types of anemia associated with low hemoglobin levels, but this seems to occur only in severe cases, and the underlying mechanisms are not well understood.[23]

SUMMARY

The serum cholesterol levels of 351 enlisted men nineteen to fifty-eight years of age (average age 30.4 years), selected at random from the Armed Forces of the Philippines, were found to vary from 73 to 274 mg. per 100 ml. with a mean of 169.7 ± 33.5 (S. D.) A group of fifty-two men aged eighteen to forty years (average age 27.6 years), who were selected for special biochemical studies by the survey team, gave a range of serum total cholesterol values of from 98 to 353 mg. per 100 ml. with a mean of 180.4 ± 43.2 (S. D.).

The dietary survey showed that in the mess halls, fat supplied a mean of 13.9 per cent of the total dietary calories which averaged 3,068 per capita. Mean values give the impression that the fat is contributed almost equally from animal and vegetable sources. The diet of twenty-eight enlisted men taking their meals at home gave a mean of 16.9 per cent of total calories supplied by fat. The low fat content of the diet may have a bearing on the rela-

tively low serum cholesterol levels obtained in this study compared to those reported for populations in the United States and northern Europe.

Statistical study of the data of both the random and non-random groups showed significant increases of serum total cholesterol values with increases in age over the range of eighteen to fifty-eight years, and with increases in diastolic blood pressure, relative body weight and serum carotene levels.

No correlation was obtained between serum total cholesterol and systolic blood pressure, serum vitamin A or hemoglobin levels.

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Editorial

On the Daily Allowance for Folic Acid

THE DISCOVERY of folic acid (pteroylglutamic acid) is one of the most fascinating stories of modern biology and biochemistry, particularly as so many disciplines, along quite separate roads, came to the same conclusion.[1] The clinical usefulness of this vitamin in treating the anemia of sprue and of other malabsorption states led many to herald it as one of the greatest therapeutic advances in modern medicine. However, since it was found not to be harmless when used in pernicious anemia,[2] voices of caution have been raised and considerable debate has ensued. Gradually the heat from both sides has diminished as more facts have become available concerning the usefulness and potential dangers in man and their relation to dosage. The intention here is to discuss dosage in relation to effectiveness and absence from known harm.

The minimum daily requirement for folic acid is unknown, although some "good guesses" can be made based on the blood response of patients with folic acid deficiency. The anemia due to folic acid deficiency, when severe, is megaloblastic and macrocytic. The cells are well filled with hemoglobin unless concomitant iron deficiency exists. In this country most patients with megaloblastic anemia responding to folic acid fall into the following categories: (1) malabsorption syndromes, especially sprue, (2) megaloblastic anemia of pregnancy (the so-called "pernicious anemia of pregnancy," a misnomer), (3) some severe alcoholics with cirrhosis, (4) some patients with an intestinal blind-loop, (5) some patients receiving anticonvulsant drugs, (6) the megaloblastic anemias of infancy and (7) rarely, in patients also suffering from scurvy.

In true Addison's pernicious anemia, the deficiency (conditioned by lack of intrinsic factor) is of vitamin B_{12}, although occasionally a deficiency (probably dietary) of folic acid may occur also. It is now clearly recognized that administration of folic acid will usually induce a reticulocyte response and at least a partial hematologic remission in pernicious anemia. The remission is usually not permanent and, much more important, folic acid does not prevent the neurologic complications of pernicious anemia and may even induce an exacerbation, possibly by causing the body to use up what little vitamin B_{12} remains. It is essential, therefore, to differentiate those megaloblastic anemias which are due to folic acid from those caused by vitamin B_{12} deficiency before treatment is begun. This usually is not possible on clinical grounds alone. Several measures have been proposed to differentiate these two anemias.

First, one may measure the amount of vitamin B_{12} in the serum. Low concentrations are always found in pernicious anemia and they are usually normal or high in folic acid deficiency.[3] The method is tedious and finicky, however, and is not suitable at present for a general laboratory. Moreover, it tells nothing directly about the state of folic acid nutrition.

Second, one may measure the urinary excretion of folic acid following a standard dose.[4,5] One must be prepared to measure urinary folic acid, not a simple task, and this test requires the administration of folic acid which will give a blood response precluding further study.

Third, when folic acid antagonists are administered, an abnormal metabolite of histidine appears in the urine: formiminoglutamic acid (FIGLU).[6] Formiminoglutamic acid has

been found in the urine of some, but not all, patients with anemia due to folic acid deficiency. The increased excretion of this metabolite does not seem to be a sensitive index of folic acid deficiency and there is evidence that it is not entirely a specific one.[7] The presence of FIGLU in the urine, therefore, does not appear to be an entirely satisfactory test for folic acid deficiency at present.

The fourth measure is the determination of the fasting serum folic acid. Indifferent results have been reported previously, but results with a new method[8] do seem to parallel the clinical degree of folic acid deficiency. The method is microbiologic using L. casei. As with the serum assay for vitamin B_{12}, this valuable technic is still suitable primarily for research laboratories.

Finally, the fifth measure depends upon the differential hematologic response of patients with pernicious anemia and folic acid deficiency to *small* amounts of folic acid and of vitamin B_{12}. The procedure is straightforward but does require careful study of the patient for ten days or more and is applicable only to patients with megaloblastic anemia. So far, six patients have been reported.[9] Three of these, considered to be deficient in folic acid, were given 400 μg. of folic acid parenterally daily with excellent hematologic responses. The other three with classic pernicious anemia did not respond to these amounts of folic acid, but did respond to 15 mg. daily and would undoubtedly have responded to vitamin B_{12}.

The suggestion is made that physiologic amounts of folic acid and vitamin B_{12} given separately will allow a clear distinction between these two diseases by the hematologic response. It is perhaps of interest that this method, depending upon clinical hematologic response, is the classic method (and, formerly, the only reliable method) for assaying liver extract and was that used by Minot and Murphy to test the effectiveness of diet and liver in the treatment of pernicious anemia in 1926. In Castle's hands it made possible discovery of the double deficiency of the intrinsic and extrinsic factors in patients with pernicious anemia.

The question may now be raised concerning folic acid in multivitamin preparations. In the past, some have recommended that no folic acid be included because of the possibility that a "false" remission of pernicious anemia would be inadvertently effected without control of the neurologic complications. It now seems likely, as noted, that patients with pernicious anemia will not respond to administration of small (400 μg. or less) daily doses to which patients with folic acid deficiency respond well. Such an amount might then be considered a reasonable daily dose and approximates the daily amount (300 μg.) recommended by the Council on Foods and Nutrition of the American Medical Association.[10] The National Research Council's Food and Nutrition Board suggested that it would seem probable "that a dietary intake of approximately one-half milligram daily can be expected to cover nutritional needs."[11] Somewhat smaller amounts probably would be satisfactory and in view of the custom of recommending two or three "doses" of a multivitamin preparation daily, perhaps the most suitable quantity in each dose would be in the neighborhood of 100 to 200 μg. The amount of folic acid absorbed from the normal diet is not known with certainty, but it is probably in approximately the same range,[5] most of it being derived from folic acid conjugates which are partially broken down in the gastrointestinal tract.

It would appear, therefore, that small amounts of folic acid in multivitamin capsules (around 200 μg.) would be effective in preventing dietary deficiency of folic acid. Since synthetic folic acid is almost entirely absorbed by the normal intestine,[5] such preparations should also suffice for the treatment of patients with simple dietary deficiency of folic acid without incurring a hazard to patients with undiagnosed pernicious anemia. The presently available oral preparations containing synthetic folic acid alone in larger doses should be reserved by prescription for patients with known intestinal malabsorption or with a specific abnormality in folic acid metabolism such as may exist during prolonged administration of anticonvulsant drugs.

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Some Indicators for a Broad Assessment of the Magnitude of Protein-Calorie Malnutrition in Young Children in Population Groups

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In recent years more attention has been paid to health problems of populations of technically underdeveloped countries. Among those populations, children are more severely affected, and protein-calorie malnutrition[1] is one of the more severe problems. Action programs directed toward the control of those conditions need to establish the magnitude and nature of the problem as the basic and preliminary step. Consequently, it is necessary to measure protein-calorie malnutrition in children, especially in rural tropical communities.

The WHO Study Group on "Measurement of Levels of Health" met in Geneva in 1955[2] and in considering several indicators of health recommended further studies on the use of indicators to measure the nutritional condition of populations. The Fifth Session of the Joint FAO/WHO Expert Committee on Nutrition met in 1957 and in its report[3] suggested that there is a need for *simple, objective "Nutritional Indicators" which can be used by general public health workers with a limited knowledge of nutrition.* The committee emphasized the importance of seeking such indicators, although the difficulties involved were fully recognized.

The aim of this paper is not to define the methods for the diagnosis of deficiency diseases but to discuss, in a preliminary fashion, several possible indicators which might be used—although realizing their limitations—to determine roughly the extent or magnitude of the nutritional problem posed by protein-calorie malnutrition in early childhood in a given area or country.

For this purpose potential indicators may be drawn from several sources, namely: (1) vital statistics, (2) anthropometric measurements, (3) clinical signs, (4) food consumption, and (5) laboratory tests.

INDICATORS FROM VITAL STATISTICS

Sebrell and Hundley[4] suggest that indirect or presumptive evidence of nutritional status can be gained from such information as crude death rate, infant mortality rate and the tuberculosis death rate.

Mortality Rate in Children One to Four Years of Age

Since the child below one year is usually protected by the mother's milk, and since the school-age child can compete at home for more and better food, the impact of protein-calorie malnutrition is specially noticed in children between one and four years of age.

It is true that in official certification of deaths, diarrhea is the first and most important cause of mortality in children under five years of age but, as has been shown by Scrimshaw et

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Indicators	Countries, Areas, Villages or Specific Groups of Population		
	A	B	C
Percentage of deaths in children under 5 years of age	5	20	50
Percentage of births with a weight less than 2.5 kg.	3	10	20
Preschool children (one to four years)			
Mortality rate in the one to four age group per 1,000	1	15	40
Anthropometric measurement (Gómez's classification)			
1st degree of malnutrition	5	20	40
2nd degree of malnutrition	3	15	30
3rd degree of malnutrition	0.5	5	10
Percentage with edema	..	3	6
Percentage with easily plucked hair	1	10	20
Percentage with a total protein level less than 6 gm.	..	3	6

al.,[5] a great proportion of deaths attributed to either diarrheal diseases or parasitism are really due to severe malnutrition. And, even more important, most of the deaths would probably not have occurred if the children had been fed properly.

From the point of view of vital statistics, it appears that the mortality rate in children one to four years of age may be a good indicator of the protein-calorie malnutrition problem in a given area or country.

Bengoa[6] in 1955 was of the opinion that when the mortality rate in the one to four-year-age-group is more than 10 per 1,000, it could probably be related to a serious protein nutrition problem, although other factors would be contributing to this high mortality. There are still countries in which the mortality rate in children one to four years of age is above 30 per 1,000, whereas in the United States of America, England and North European countries it is about 1 or 2 per 1,000.

The best way to express this mortality is undoubtedly by means of the specific one to four mortality rate (number of deaths among children aged one to four years divided by the population one to four). However, official statistics in technically underdeveloped countries are usually inaccurate, and, even if that was not the case, the population one to four has to be estimated, and consequently is not accurate. This mortality has also been expressed as the per cent of deaths among children aged one to four from the total number of deaths.

Wills and Waterlow[7] have suggested that the ratio of death rates for children aged one to four years to that of infants aged one to twelve months might serve as an index. The death rates are expressed by Wills and Waterlow as a percentage of all deaths registered.

INDICATORS FROM ANTHROPOMETRIC MEASUREMENTS

The Birth Weight

The many references on this subject are well known and will not be included here. Generally speaking, it is agreed that the nutritional status of the mother has some influence on the weight of the fetus, along with other factors such as racial genetic influences, the age of the mother, sex, plurality of birth and certain diseases.

Platt[8] has suggested that a record of birth weights of infants may provide a useful indicator of the state of nutrition of mothers and possibly of the community generally.

The question arises as to the best way of using the birth weight as an indicator. The average of the total figures in a given population does not show the variations which exist in countries with different levels of nutrition. It appears to be more satisfactory to obtain the percentage of newborns with a weight below a conventional arbitrary figure, for instance, 2.5 kg. (this figure corresponds incidentally with the prematurity index).

Alternatively possibly more useful information might be obtained by using an index based on a comparison of the birth weight of the poorly nourished lower socioeconomic groups of a country or region with that of the apparently well nourished upper socioeconomic group of the same genetic composition. Jelliffe[9] has suggested that this index might be termed the

"socioeconomic birth weight quotient," defined as:

$$\frac{\text{average birth weight in lower socioeconomic group}}{\text{average birth weight in upper socioeconomic group}} \times 100$$

The difficulty with this index may be largely in defining and discovering the upper socioeconomic group considered to be "well nourished."

Assessment by Weight of Preschool Children

For some years the Mexican School of Pediatrics, under the direction of Dr. F. Gómez, has advocated the classifying of malnutrition in early childhood into three categories or degrees, depending upon the percentage deviation of the weight below the average for the group.[10]

1st degree of malnutrition = from 75 to 90% of the "average" weight
2nd degree of malnutrition = from 60 to 75% of the "average" weight
3rd degree of malnutrition = below 60% of the "average" weight

As an experimental approach to the use of this classification in field surveys the following results were obtained in three studies carried out in Central America and the Caribbean area:

Degree of Malnutrition	Country A[11]	Country B[12]	Country C[13]
1st degree	41%	54%	37%
2nd degree	36%	20%	21%
3rd degree	7%	2%	3%
Normal	16%	24%	40%

The names of the countries are not given because the types of population surveyed were not the same in the three studies and the results are not comparable from a statistical point of view. However, the results clearly suggest that this classification may be used as objective indicator of the prevalence of protein-calorie deficiency in the child population.

The strongest objection to using this classification is that the children's ages are often not known precisely. In some instances, it may be possible to check with birth certificates, but usually these do not exist, so that approximations may have to be made, based on the age as stated by the mother checked against locally important "time-marking" events, both natural and political.

Another controversial subject concerns the definition of the "average" weight, which, of course, it is necessary to obtain in a previous study in order to apply Gómez's classification correctly, although frequently standards obtained from elsewhere (i.e., United States of America or Europe) may be used. This may make for confusion and the standards used must be clearly defined. Perhaps ideally this type of result might be given *both* in relation to local standards *and* to widely accepted arbitrary standards universally recognized as a yardstick, as, for example, is the case with the 2.5 kg. level for birth weight.

Obviously this classification has certain limitations. For example, it does not differentiate between the different *forms* of malnutrition. However, it is undoubtedly one of the most important devices for measuring the public health significance of protein-calorie deficiency diseases in the preschool age group as in each syndrome, especially in kwashiorkor and nutritional marasmus, a low body weight is a constant finding. In addition, differentiation into the three degrees permits a grading of the nutritional status of a preschool child population which cannot be achieved in any other way.

Arm Muscle and Fat Measurement

It seems possible that a rough gauge of depletion of calories and proteins may be obtained by directly measuring the body's principal stores, that is, subcutaneous fat as an index of calorie inadequacy, and voluntary muscle for evidence of protein depletion. Based on this principle, one of us (D. B. J.) has tentatively suggested the low arm circumference index.[14]

This would be based on the fact that, in all forms of protein-calorie malnutrition in preschool children, muscle wasting appears to be a marked and constant feature. The mid-upper arm circumference, at the level of the belly of the biceps, can be simply measured and may give a rough gauge of muscle depletion. Aver-

age values of apparently normal children require to be known for the particular population. The low arm circumference index might then be defined as the percentage of children whose measurements fell below a pre-agreed level, possibly 80 per cent of the average values in "normal" children. Plainly this approach requires considerable further thought, as well as field trial.

Height and Weight of First-grade Children

Hundley et al.[15] have shown that the height and weight of first-grade children (six to seven years old) may yield an index of nutritional status of sufficient sensitivity to detect favorable or unfavorable trends of less than "mass starvation" magnitude.

INDICATORS FROM CLINICAL FINDINGS

Two main practical difficulties have been found in the use of clinical surveys to evaluate the prevalence and incidence of a given deficiency disease. First, there are several signs which are not specific to a given deficiency and, second, the estimation of many of the clinical signs is very subjective.

Jolliffe[16] used several key clinical signs as indices in order to evaluate the incidence of deficiency diseases in Newfoundland, e.g., angular stomatitis in riboflavin deficiency; follicular keratosis of arms in vitamin A deficiency; and red hyperemic gums in ascorbic acid deficiency.

The same approach has proved to great value in public health activities in Venezuela where key signs have been used for some time as a measure of the incidence of certain deficiency diseases.[17]

Edema

In a recent review[18] of the clinical aspects of kwashiorkor, the basic features were found to be: growth retardation and edema.

Growth retardation has already been suggested in this paper as an anthropometric indicator. It may also be possible to consider edema in preschool children as a key sign or indicator of protein-calorie malnutrition. Apparently there are few other conditions, from the public health point of view, that commonly produce significant cases of edema in tropical preschool children. The fact that it may also occur in some children with renal disease, severe anemia and beriberi does not prevent its use as an indicator of malnutrition in infants. The edema must be tested in the pretibial region, with a "moderate" pressure with one finger for approximately three seconds. A prolonged pressure, especially in the hot weather found in tropical areas, may produce minimal pitting even in well nourished normal subjects.[18] If there is any doubt as to the validity of the pitting test, the edema must not be recorded.

In spite of the lack of complete objectivity in the appreciation of edema, it does appear that this sign, carefully tested for, can provide considerable public health information, provided other causes of edema are excluded in doubtful cases. It must, however, be realized that, as only one form of advanced protein-calorie malnutrition shows edema, this index will give an indication of only one facet of the problem.

Easily Plucked Hair

Changes in hair are almost constantly present in protein malnutrition. Alterations in the color, texture, straightness, denseness and "pluckability" have been described. In children who live in the environment of tropical areas, where sunshine, dust and lack of hygiene are prevalent, it is difficult to establish when the color and the texture are abnormal. These factors, however, will not alter "pluckability," and easily plucked and detachable hair has been suggested by Guatemalan workers as an additional indicator of protein malnutrition. The sign is investigated as follows: A group of 20 to 30 hairs from the anterior half of the head is taken between the thumb and index finger and pulled firmly and steadily. In an undernourished child ten or more hairs will be plucked easily and without pain. In a study carried out in Guatemala by one of us (C. P.) it was shown that 27 per cent of preschool children in a poor rural area had this sign, and a significant statistical correlation was found between this sign and the weight of the children. A main difficulty with this test lies in

standardization of positiveness, that is, how many hairs plucked out and how hard it must be pulled.

Alternative hair signs have either been suggested or might be worth investigating. A "hypochromotrichia" index has been considered, based upon lightening in the color of children's hair.[19] Difficulties are numerous, and include the problem of defining hypochromotrichia in relation to color change, area of scalp and length of hair involved, as well as a lack of complete correlation between this change and protein-calorie malnutrition.[13]

INDICATORS FROM FOOD CONSUMPTION AND COST OF FOODS

The United Nations Report on International Definition and Measurement of Standards and Levels of Living[20] suggested the following indicators from food consumption data: "(a) National average food supplies in terms of calories at the 'retail level' compared with estimated calorie requirements. (b) National average food supplies in terms of total proteins at the 'retail level,' and (c) National average food supplies in terms of animal protein at the 'retail level.' "

As the same report says, the average availability of food is, of course, not a direct measure of nutritional intake; neither does it give an indication of the distribution of food within the population. However, it may be of value.

The fact is that much better information is obtained through actual patterns of consumption on a family basis, or even better, on an individual basis, especially in preschool children. However, the technic for carrying out such surveys is not so easily undertaken by non-specialized personnel. This kind of study could be considered as supplying fundamental complementary information to that obtained from the indicators under discussion.

A simple indicator in relation to foods and infant malnutrition might be to compare the cost of a liter of milk (or its equivalent in dry milk) with the average salary of non-qualified workers in agriculture and industry, in the area or country. Although in certain countries milk is not a usual food in infant feeding, in most countries this indicator could provide a reasonable background to infant malnutrition problems. In areas or countries where the cost of a liter of milk is $0.20, and the salary $1.00 the reason for the frequency and comparative prevalence in certain areas and countries is quite understandable. Although it is not in itself an indicator of infant malnutrition, it might be considered as an indirect appraisal of the situation.

INDICATORS FROM LABORATORY TESTS

In spite of the enormous advances in the field of nutritional biochemistry, there is no new test available which can be used in field surveys as an indicator of protein malnutrition.

Hitherto, serum protein levels have been used to measure the level of protein nutrition, and all workers report very low figures of serum protein in kwashiorkor, about 4 to 4.5 gm.

During a recent survey made by INCAP[21] in a poor sector of Guatemala City, clinical indications of pre-kwashiorkor were found in 6 of 100 children. The total serum protein of these six children was: 4.50; 5.48; 6.24; 5.74; and 5.67. The rest of the children had an average of 6.73 ± 0.34. Frequently in field surveys the figures on serum protein are given as average, sometimes with the standard deviation. It would be more practical for our purpose to give the frequency distribution at different levels, and particularly the percentage below an arbitrary figure, for instance, 6 gm. This value could offer more than presumptive evidence of the morbidity of protein malnutrition. However, to take this indicator independently of others suggested in this paper would be of little value. This indicator, as the others, must be considered and analyzed in conjunction with other factors.

There is no doubt that albumen levels would be a better indicator, but the problem is that whereas the total protein level is easy to obtain, even in rural areas with a densimetric method, the determination of albumen levels needs special equipment.

In addition, as will be appreciated, even standard serum samples may be difficult both to collect and transport in unsophisticated, relatively remote tropical communities, especially as blood will usually have to be taken from either the external jugular or femoral

veins in children of this age; while interpretation of results, especially from one part of the world to another, may not be straightforward, owing to interrelated effects on the levels of plasma proteins of the immune processes occurring in hyperendemic malaria, or of intestinal helminth infection, or of liver damage. However, despite these objections, this does seem to be the most potentially useful approximate laboratory public-health indicator of protein-calorie malnutrition.

Platt and Heard[22] have suggested that the determination of urea nitrogen and ammonia nitrogen as a proportion of the total urinary nitrogen may offer a simple method of assessing nutritional status with respect to protein. This test has the great merit of simplicity, as a single morning specimen of urine provides all the required information. This indicator could be of value, but requires much further testing.

The possibility of using hair samples does not appear to have been considered; although some workers have found the cystine to be low in the hair of children with kwashiorkor,[23,24] while others have not.[19,25] There is plainly need for much further work into chemical and physical differences (if such exist consistently) between the hair of normal children of a particular ethnic group and those with protein-calorie malnutrition. The advantages of hair samples in relation to ease of collection, transport and storage are self-evident.

CONCLUSIONS

We realize that the indicators presented herein by no means represent a completely satisfactory solution to the problem. However, we do believe that these would at least serve as first steps toward the attainment of the highly desirable objective indicated in the introduction, namely the definition of simple indicators to be used by general public health workers with limited knowledge of nutrition.

It is obvious that it will be difficult to find a simple indicator which by itself can show the extent of infant malnutrition and serve to evaluate the problem. These indicators also need careful interpretation in association with background information on the health situation of the area, dietary habits, etc.

An important aspect of the problem is that the accuracy of the evaluation of malnutrition in infants must be consonant with the required uses of the data. For example, it may not be necessary to know with great precision whether the preschool mortality rate in a given country is 40 or 50. In either case, the same policy and administrative action would undoubtedly be indicated. It is important, however, to know, at least approximately, how precise measurements are, that is, to know their relative margins of error. This and other related problems involved in the use of indicators have been clearly pointed out by the Report on International Definition and Measurement of Standards and Levels of Living.[20] It is also equally important to know whether or not a sample in which the indicators proposed have been used is representative of the whole population or of a selected group. In the latter case, this group should be clearly defined and its numerical importance in relation to the total population should be indicated.

It is our opinion that indicators to be used in determining the severity of infant malnutrition by public health workers must be based on some essential principles: (1) The indicators must be *simple* to collect and to interpret. (2) They must be as *objective* as possible. (3) They must be *numerically measurable*, so that they can also be used in evaluation programs. (4) They must be as *specific* as possible, but not necessarily completely so. Very few signs in medicine or in public health are absolutely specific.

It is unnecessary to add that these indicators do not replace the traditional anthropometric measurements, clinical surveys and laboratory tests in a given population.

The following table is a theoretic example of some of the indicators discussed in order to demonstrate their possible use in evaluating the public health significance of protein-calorie malnutrition.

SUMMARY

Protein-calorie malnutrition in preschool children is probably the most common and important nutritional problem in the world today. To assess the effect of both planned

would-be ameliorative public health measures and also such unplanned socioeconomic and cultural changes as are occurring everywhere, it is necessary to measure the dimensions of this problem on a broad public health basis.

The present paper outlines certain steps in this direction and suggests possible simple potentially useful indicators derived from the following sources: (1) vital statistics, (2) anthropometric measurements, (3) clinical signs, (4) food consumption and (5) laboratory tests. Advantages and limitations are discussed. Probably a combination based on data from all these sources would be most valuable. The need for further investigation is stressed.

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Amino-Aciduria in a Case of Scurvy

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SCURVY can be regarded as one of the classic diseases, occurring with comparative rarity today. A most excellent account of human scurvy was given in 1753 by Lind, who detailed his experiences with thousands of cases, seen while he was a naval surgeon. This work has recently been republished,[1] a remarkable tribute to its merit.

Today there is a tendency for scurvy to occur in the extremes of life, and cases are becoming so uncommon that isolated cases are often considered worthy of publication.[2,3] Of the case reports published in more recent years, a high proportion of cases have occurred in the group of elderly men who live alone and neglect to maintain a sufficiently high dietary intake of vitamin C. In 1944, McMillan and Inglis[4] reported several such cases and applied the term "bachelor scurvy" to them. More recently, Cutforth[5] described eleven cases of adult scurvy, and it is worthy of note that seven of these were in elderly men, who could be assigned to the class covered by bachelor scurvy.

It has been known for many years, that scurvy is accompanied by disturbances of metabolism involving phenylalanine and tyrosine. As long ago as 1907, Stokvis[6] described the darkening of urine voided by a scorbutic patient, due to its abnormal phenylpyruvic acid content. More recently, Boscott and Cooke[7] have described a series of investigations which they made into cases of steatorrhoea and macrocytic anaemia, and they attributed the presence of hydroxyphenylacetic acid in the urine as being due to deranged tyrosine metabolism caused by deficiency of ascorbic acid.

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Amino-aciduria in scurvy has been studied quite extensively by Jonxis[8,9] in children, and in many instances in conjunction with a vitamin D deficiency. The following were the main facts demonstrated: (1) It was usual for about three weeks' treatment to have been applied before the amino acid pattern of the urine returned to normal. (2) In cases in which subperiosteal haematomas were present, the amino acid excretion became increased during the early stages of treatment. It was concluded that when such haematomas were absorbed, amino acids which had become bound to blood decomposition products were released. (3) The most pronounced increases in amino acid excretion were in taurine, threonine plus serine, glycine plus alanine, histidine and lysine plus β-alanine complexes.

In view of these interesting facts, it is rather surprising that in the many cases of adult scurvy reported, references are rarely made to chromatography of the urine, with a view to demonstrating amino-aciduria. When a patient with an advanced case of bachelor scurvy presented himself, we thought that in addition to determining the presence of the amino-aciduria (if any) by the two-dimensional technic of paper chromatography after electrolytic desalting of the urine, we might also apply a simple one-dimensional technic with which we had been experimenting. If it were successful in demonstrating amino-aciduria, we might offer it as a simple alternative method, which could be used when lack of time or facilities prevented a more complete chromatographic investigation. The conventional tests of ascorbic acid deficiency are not entirely satisfactory, the most usual test, the ascorbic acid saturation test, having suffered periodic criticism.[10,11] It would seem to us from the little experience so far obtained, that when

FIG. 1. Extensive hemorrhages of the left leg.

amino-aciduria does occur in scurvy it manifests a magnitude in keeping with the severity of the disease. This does not always seem to be true with the ascorbic acid saturation test. The patient to be described was quite ill, and had amino-aciduria which was quite easy to demonstrate. However, in other milder cases of scurvy which we have seen in both children and adults, amino-aciduria was either not present or slight.

For the purpose of investigation we took urine samples daily and prepared two chromatograms from each daily sample. (1) One was a two-dimensional chromatogram, using an electrically desalted urine sample, and employing phenol for the first run, and tetrahydro-furfuryl alcohol for the second. (2) The other was a one-dimensional chromatogram, employing the technic to be described later. We found that by using this one-dimensional technic we could demonstrate and follow the amino-aciduria with little trouble, although it was not as accurate as the more time consuming two-dimensional technic.

CASE REPORT

The patient was a seventy-three year old man who had been a widower for twelve years. Living alone, he had, during the latter part of this period in particular, failed to maintain a diet which provided an adequate amount of vitamin C. On close questioning regarding his diet, it was found that he had lived mainly on chips and fish, with bread and margarine. He consumed a moderate quantity of alcohol as draught beer. The only food which he cooked for himself was vegetable stew which he always boiled for long periods of time. It is interesting to note that a proprietary brand of fortified margarine satisfied his basic requirements of vitamins A and D. The patient could not remember the last occasion on which he ate fresh fruit, but was certain that it was many years ago.

When he was first seen in the outpatient's department he complained of constant pain and swelling of the left leg, so severe as to prevent walking or even moving the leg. He also complained of infrequent pains in his right thigh, and he was breathless and pale.

On examination, his left leg was swollen and indurated, and there were extensive haemorrhages extending along the anterior part of the leg, passing up the thigh and reaching the buttocks. Similar haemorrhages with induration were present in the back of the right thigh (Fig. 1). The blood pressure was 160/90 mm. Hg. Nothing abnormal was felt in his abdomen, and the central nervous system was normal. He was edentulous, and there were no lesions to be seen in the mouth. From the clinical signs, and in view of the history, a diagnosis of scurvy was made and he was admitted to the hospital immediately.

Laboratory Findings

The laboratory findings were as follows: Serum proteins: Total protein was 5.0 gm./100 ml.; albumin, 3.2 gm./100 ml.; and globulin, 1.8 gm./100 ml. Vitamin A, 60 μg./100 ml. (normal) and carotenes 30 μg. /100 ml. Vitamin B_1 (pyruvate metabolism test) blood pyruvate, first specimen 1.0 mg./100 ml.; second specimen, one hour after the administration of 50 gm. glucose, 1.25 mg./100 ml.; third specimen, two hours after the administration of 50 gm. glucose, 1.15 mg./100 ml. (suggests a mild deficit of vitamin B_1). Vitamin C (serum) under 0.4 mg./100 ml. Haemoglobin 44 per cent (6.4 gm./100 ml.), white cells 5,100 per cu. mm., differential and morphology normal, platelets 200,000 per cu. mm., red cells normochromic, some anisocytosis and a few poikilytic forms, reticulocytes 2 per cent. Stools, dark in color, occult blood test positive, barium meal showed no abnormality. Urine, first specimen (before treatment) gave some slight reduction of dichlorophenolindophenol reagent, vitamin C content probably nil. Subsequent specimens taken at daily intervals, after treatment had commenced, gave similar results up to the sixth day, when vitamin C was first positively identified in the urine, at a level of 10 mg./100 ml. Further daily specimens gave vitamin C levels of 8.3 mg./100 ml., 8.3 mg./100 ml., 4.4 mg./

FIG. 2. One-dimensional chromatograms, run for thirty hours ascending, and using the butanol-formic acid-water solvent. First specimen. Before treatment: increased excretion of phenylalanine and leucine (top 2 bands) and the smaller molecular weight amino acids, alanine, threonine, glycine and serine (middle bands). Second specimen. Haematoma resolving: further increase in excretion of threonine and glycine. Third specimen. After six days of treatment: amino acid pattern about normal.

100 ml. and 4.0 mg./100 ml., after which examination was not made daily, but only occasionally as a precautionary check.

Urinary Amino Acids

Specimens 1, 3 and 5 were selected for the one-way amino acid chromatograms shown in the illustration (Fig. 2). Specimen 1 showed amino-aciduria with the following amino acids excreted in abnormal amounts: phenylalanine, leucine and isoleucine, methionine, alanine, serine, glycine, threonine, arginine, and possibly aspartic acid. Specimen 3 showed that the amino-aciduria had become more marked in the course of two days, and specimen 5 showed a practically normal amino acid pattern after six days of treatment.

It will be noted that the tests indicated a slight vitamin B_1 deficiency, but that vitamin A was not deficient. On these grounds, and in view of the patient's diet which had included a sufficiency of margarine, it was

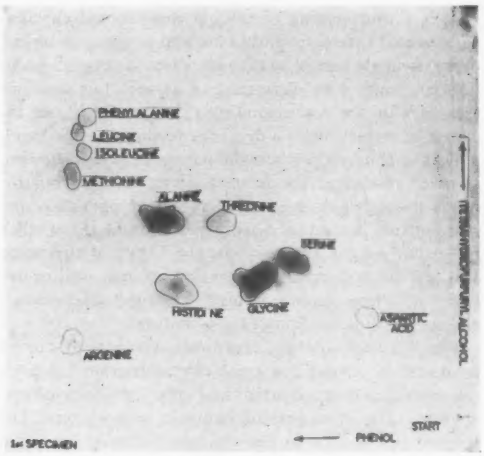

FIG. 3. Two-dimensional chromatogram of the first urine specimen.

considered that vitamin D was probably not deficient either. This case could therefore be regarded as primarily one of vitamin C deficiency.

The anaemia was in accordance with the findings of other workers,[13] who report that 70 per cent of scurvy cases are complicated by anaemia.

The patient responded well to treatment with 500 mg. of ascorbic acid administered parenterally twice daily, and 5 mg. of ferrous gluconate administered twice daily. In five days he showed a reticulocyte response of 15 per cent. Within a month of admission his haemoglobin had risen to 70 per cent (10.2 gm./100 ml.) and the haemorrhages in his legs gradually disappeared. One month after admission the right leg still showed some slight evidence of haemorrhage, while the left leg showed only slight discolouration with desquamation. He could walk about the ward without any dyspnoea, and with no swelling of the ankles.

Chromatographic Findings

The progress as followed by the one-dimensional paper chromatograms of the urinary amino acids was very interesting. Three of the chromatograms are shown, along with a normal control for comparison (Fig. 2). Of these, the first, which is from the patient's urine on admission, shows an abnormal pattern as compared with the normal control. At the top of the strip increases in phenylalanine and leucine are apparent, while lower down in descending order, the bands representing alanine, glutamine-threonine, glycine, and asparagine-serine are increased. These increases were confirmed by the two-dimensional chromatogram for which an electrically desalted urine was used. In this case the following amino acids were shown to be in excess (Fig. 3): phenylalanine, leucine, isoleucine, methionine, alanine, serine, glycine, threonine, arginine, and possibly, aspartic acid.

It is a shortcoming of the one-dimensional chromatogram that threonine-glutamine and asparagine-serine, occur as single bands, so that increases in threonine and in serine cannot be distinguished as such but occur as increases in the corresponding dual band, i.e., an increase in serine causes a deeper asparagine-serine band.

On the third day, when the haematoma was showing signs of resolving, the urinary amino acid chromatogram showed a decreasing excretion of phenylalanine and leucine, but an increasing excretion of the smaller molecular weight amino acids, the bands of threonine and glycine in particular, denoting an increased excretion of these amino acids. The two-dimensional chromatograms confirmed these findings.

Finally, after six days' treatment, the patient's urine produced a virtually normal chromatogram on both the one-dimensional strip and the two-dimensional square. The photographs, being in monochrome, fail to give full justice to the changes reflected, as these were very apparent indeed on the original strips.

The method employed for producing the one-dimensional strip was a modification of that by Awapara and Sato.[13] The original method involved desalting the urine by employing an exchange resin, Dowex 2. This technic we found rather time consuming and never really very satisfactory. Certainly it could not compare with electrolytic desalting. Therefore we made a trial with untreated urines, and in spite of the adverse criticism of this method by the authors, we were pleased with the results, and had been using it along with the better known one-dimensional technic of Dent[15] (using phenol) as a routine screening test, prior to two-dimensional chromatography.

When the method was applied to the urine specimens from our scorbutic patient, the results were so gratifying that it was thought it might be offered as a simple method which could be applied in similar cases.

Method for One-Dimensional Chromatography

The paper used was No. 1 Whatman, strips of 18 inch length, being cut from a 2 inch wide roll. The start line was drawn $1\frac{1}{2}$ inches from one end, and the urine applied with a finely drawn out pipette in a narrow band, the aim being to keep the band of applied fluid as narrow as possible. Each application was allowed to dry before the next was applied.

The amount of urine used was 0.1 ml. and in this case, since the patient's urine was concentrated, it was adjusted to the same specific gravity as the control. A determination of nitrogen would have been too time consuming to justify inclusion in a simple method. The amount of application may appear to be rather large, being in the nature of four times the usual amount, but it must be remembered that the application is right across the 2 inch wide strip, and we found that smaller applications were not successful. It has in fact been stated that a moderate excess of a normal urine will not produce an abnormal amino acid chromatogram.[14]

The strips were then suspended vertically with about $1\frac{1}{4}$ inch of the end dipping into the solvent, so that the level of the top surface of the solvent was about $\frac{1}{4}$ inch from the start line. The solvent used was monophasic, and does not appear to have had wide publication. It is: butanol, 75 parts; formic acid, 15 parts; and water, 10 parts. It suffers from two minor disadvantages: (1) it tends to esterify, so that prolonged runs of three days are not satisfactory, and (2) it appears to work best at temperatures around 22°C. and it will not work well in cold weather if the temperature is allowed to fall to around 16°C. However, it was found that a run of about thirty-six hours maximum, was quite satisfactory, and in very cold weather, the temperature problem can be solved by resorting to such devices as leaving a hot plate (or a Bunsen burner) on in a fume cupboard.

The strips were dried at 37°C. in an incubator (heating above this temperature should be avoided) and, when dry, dipped in a 0.5 per cent solution of ninhydrin in acetone, and returned to hang in the 37°C. incubator. After an hour or two the staining becomes fairly intense, and seems to achieve a maximum after about twelve hours. The strips can then be placed alongside the normal control, with the start lines opposite and comparisons made with the normal. It should be borne in mind that *small* increases in certain amino acids (glycine, alanine, serine, taurine, glutamic acid) have no clinical significance.

SUMMARY

A case of "bachelor scurvy" is described in which the patient is in an advanced state of vitamin C deficiency.

An attempt was made to determine the presence of amino-aciduria, and it was found that this case was not markedly different from those already described. During the period when haematoma was being resolved the amino-aciduria increased. Increased excretion of threonine and glycine was particularly well marked.

This patient responded almost dramatically to treatment, and the rapid physical changes were reflected by the extent of the amino-aciduria. The return to a normal amino acid excretion was only a matter of about one week, as compared to three weeks reported in children.

A simple method for one-dimensional chromatography is given, by which it was possible to follow the course of the amino-aciduria.

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We should like to express our gratitude to Dr. J. S. Parkinson and Dr. D. Longson for their permission to publish the case, and the staff of the Biochemistry

Laboratory at the Hospital for their help, particularly Mr. P. Yates, F.I.M.L.T. and Mr. T. Byrne, who carried out most of the chromatography.

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Reviews of Recent Books

Hypertension. The First Hahnemann Symposium on Hypertensive Disease, edited by John H. Moyer. W. B. Saunders Co., Philadelphia, 1959, pp. 790, $14.00.

The editors are to be congratulated for the speed and skill with which they have documented this informative symposium. The book contains many fine illustrations and charts to complement the text.

The initial part of the symposium is devoted to the clinical manifestations and etiology of hypertension. The latter part of the book is oriented to treatment of hypertension by medical and surgical means. The clinical pharmacodynamics and therapeutic use of drugs are presented. The panel discussions that follow the presentation of various subjects are lively and informative. The members of the panels are competent men who have contributed to the knowledge in the areas discussed.

This book should be of great interest and value not only to those who treat hypertension but also to those who are interested in investigation. O. M. HELMER

Long Term Illness: Management of the Chronically Ill Patient, edited by Michael G. Wohl. W. B. Saunders Co., Philadelphia, 1959, pp. 748, $17.00.

There was a time, not long ago, when the physician was chiefly concerned with the acutely ill patient. As a result of the recent revolution in medical science, spearheaded by the conquest of many infections and nutritional diseases and by advances in public health and preventive medicine, the complexion of medical practice has changed. Today the physician finds that more and more of his work involves the patient with a long term illness. The problems which the chronicity introduces alter the complexion of medical management.

This book is a comprehensive survey of this modern approach. The seventy-nine authors cover the field from alcoholism to cerebral palsy, from obesity to leprosy. Following a section on general principles, including such subjects as home care, rehabilitation and multiphasic screening, there is a systematic coverage of diseases of various organ systems. Emphasis is on management and, in general, the recommendations are orthodox time-tested procedures. Particularly helpful are chapters on the care of the patient with malignant disease (and all that *that* means), chronic deafness and blindness and emotional illnesses requiring continued treatment. For example the latter chapter answers the practical question "How do I get the patient to go to a psychiatrist?" The editor, Wohl, writes on obesity and Goodhart on nutrition in chronic diseases. Although traditional topics are treated, the emphasis here, as elsewhere in the book, is on the problems raised by reason of long standing disorders.

That chronic illness is not a monopoly of the aged is indicated by Merritt and Davison in a chapter on chronic diseases in childhood. As C. D. Leake says in his introduction to the book, the medical management of patients with long term ailments directly affects the welfare of about one-eighth of our population.

By stressing chronic illness, rather than "geriatrics" with which it is still erroneously confused, the authors have performed a valuable service. This fine book is notable proof of their valiant efforts. S. O. W.

Haematology. *British Medical Bulletin*, vol. 15, No. 1, January 1959. The British Council, London, pp. 1–88, $3.25.

The *British Medical Bulletin* is a quarterly published by an agency of the British Government. Each issue is devoted to a single topic and the articles are refreshingly short, clear and current. Their traditional high quality is reflected in the January 1959 number on hematology. Professor L. J. Witts of Oxford is the editor, and the contributors are all prominent British investigators. The sum total is an excellent review of the most salient aspects of fundamental hematology.

Readers of this Journal may be especially interested in Callender's paper on iron absorption, Mollin's on radioactive vitamin B_{12} and Girdwood's on folic acid. Equally significant is Ingram's report on the genetics of abnormal hemoglobins—a big step forward in understanding of "molecular disease." Indeed all the articles may be commended. Perhaps the best description may be found in Witt's introduction. "It is a story which can be read with equal interest by those who are engaged in the treatment of patients and those who enjoy seeing nature so brilliantly put to the question." R. S. W.

Blood Groups, *British Medical Bulletin*, vol. 15, No. 2, May 1959. The British Council, London, pp. 89–174, $3.25.

This is the second of two issues of the *British Medical Bulletin* which deal with hematology. Like the first, this is an authoritative and succinct summary for the non-specialist, as well as for geneticists, anthropologists and biologists in general.

The inheritance of blood groups is discussed by Race and Sanger and the significance of blood groups in genetic linkage by Lawler and Renwick. Mourant, the editor of this volume, presents an interesting account of blood groups and anthropology and the evidence that blood groups are affected by natural selection is presented by Sheppard. The general biologist will find these articles informative as well as those on animal and human blood groups by Joysey and on hemagglutinins in seeds by Bird. Medically oriented readers will be interested in the discussion of the factors determining the relative importance of different blood group antibodies by Mollison, the antiglobulin reaction by Coombs and Roberts and the adsorption of blood group substances on to red cells by the Sneaths. Hemolytic disease of the newborn is discussed by Roberts and its treatment by Walker. The biochemistry of human blood group substances is reviewed by Morgan and Watkins.

All the articles are brief; they are written clearly and are accompanied by instructive diagrams. The authors are all well known for their understanding and contributions to the field. This is a most valuable compendium. M. M. WINTROBE

Year Book of Endocrinology, 1958–1959, edited by G. S. Gordon. The Year Book Publishers, Chicago, 1959, pp. 384, $7.50.

The *Year Book of Endocrinology* for 1958–1959 contains well written condensations of the more important papers on clinical endocrinology published during 1958. Some of the original illustrations are reproduced and there are numerous brief but valuable editorial comments.

Dr. Gordon's enthusiastic introduction shows that endocrinologically-speaking we live in exciting times. His book is invaluable to those who wish to keep abreast of recent work but lack the time or opportunity to peruse the numerous journals through which the original papers are scattered. G. WALKER

Abstracts of Current Literature

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LIPID METABOLISM

The absorption of fat from the intestinal tract involves the hydrolysis of triglycerides of free fatty acids by the action of digestive lipases aided by the emulsifying action of bile acids. Water-soluble complexes are found which enter the surface of the absorbing cells. The fatty acids are esterified to fats and phospholipid which are absorbed principally of the lymphatics. The use of I^{131}-labeled fatty acids for evaluation of absorption dynamics has become a popular mode of study although the validity of the method has been disputed. This is particularly true with reference to the disposition and utilization of the labeled fats.

The Absorption, Transport, and Deposition of Fat: Application of a New Method for the Determination of I^{131}-Lipid Activity in Dogs and Man. D. A. Turner. *Am. J. Digest. Dis.*, 3: 595, 628, 1958.

This paper presents an extensive series of studies in dogs of the absorption, transport and deposition of I^{131}-labeled triolein and oleic acid, and parallel absorption experiments in man. The pertinent literature is reviewed in detail, providing more material on the subject than can be mentioned in this review. Although some observations have been reported by others, their sum total presents a provocative view of the infant state of our knowledge of fat metabolism.

The available data providing an experimental basis for the I^{131}-triolein and I^{131}-oleic acid tests are presented with details of technic and critical evaluation. The evidence that the labeled triglyceride and fatty acid are handled by the organism in the same fashion as the unlabeled appears to be inconclusive and calls for additional study. However, the results are comparable to those obtained by other methods. In man, the method may not distinguish between increased absorption and delayed deposition.

Interestingly, when dextrose was fed with the I^{131}-triolein meal in dogs, the blood lipid radioactivity curve was flattened, suggesting decreased absorption. Casein had an opposite effect. Less consistent results were obtained when I^{131}-oleic acid was substituted for triolein. The administration of Tween 80 and monoglyceryl stearate had little effect on the I^{131}-triolein tolerance curve. However, when choline or lecithin was fed with the triolein meal, the blood lipid radioactivity curve was significantly elevated, indicating enhanced absorption. Similar but less consistent changes occurred with I^{131}-oleic acid. After the intravenous administration of heparin, there was no effect on plasma lipid activity in the younger dogs but plasma turbidity was reduced, indicating absorption was unchanged quantitatively but the physical state of plasma lipid was altered.

In older dogs, the plasma radioactivity and plasma turbidity following the administration of I^{131}-labeled triolein and oleic acid was greater than in the younger dogs. Following heparin therapy, both plasma-lipid activity and plasma turbidity were reduced.

Fat deposition was studied by determining the radioactivity of tissues three hours after the ingestion of a meal containing I^{131}-triolein. The highest activity in young dogs occurred in the liver, spleen and myocardium with lesser activity in the skeletal muscle, kidney and pancreatic tissue, and only traces in lungs and brain. In older dogs, the greatest activity was noted in the lungs, the tissue levels of that organ showing fifty times that of the younger animals.

Following the intravenous administration of a labeled triolein emulsion, the greatest radioactivity was in the lungs with liver and spleen following in that order, suggesting an affinity for the reticuloendothelial system. Over 50 per cent was utilized in one hour. In older animals triglyceride utilization was slower.

No explanation was found for the numerous signifi-

cant differences in fat metabolism in the older and younger animals. Atherosclerosis was not found in the older dogs at autopsy.

In patients with hyperlipemia, the ingestion of I^{131}-labeled triolein was followed by four times the usual plasma radioactivity levels which persisted abnormally, suggesting a failure of deposition of the labeled triolein similar to the failure to deposit unlabeled dietary lipids in such patients. J. B. HAMMOND

Limitation of Radioiodine As a Label for Fat. E. Van Handel and B. D. Zilversmit. *J. Lab. & Clin. Med.*, 52: 831, 1958.

The behavior of triolein I^{131} was studied in dogs and rats by comparing the I^{131} content with chemically determined fat in lymph and blood and by administration of fats labeled with C^{14} and I^{131} and determining lipid I^{131}-C^{14} ratios in the fats of lymph and tissue.

I^{131} triolein given intravenously disappeared at the same rate as natural fats while the plasma concentration of I^{131} triglyceride was lower than chemically determined fat after oral administration. The distribution of I^{131} oleic acid in the neutral fat fraction of rat carcasses after oral administration was similar to that of C^{14}-oleic and C^{14}-stearic acid despite the fact that the liver lipids of these animals contained little or no I^{131} and significant amounts of C^{14}. G. HOLLIFIELD

Effect of Pre-feeding of Fat on I^{131} Triolein Absorption in Subtotal Gastrectomy Patients. M. P. Tyor and J. M. Ruffin. *Proc. Soc. Exper. Biol. & Med.*, 99: 61, 1958.

The absorption of I^{131}-labeled triolein which was studied by measuring blood and fecal radioactivity was impaired in ten of twelve patients with a Billroth II partial gastrectomy when the test substance was taken fasting, but not when it was taken thirty minutes after a dose of non radioactive peanut oil. It is suggested that in the first instance the labeled triolein was not fully digested because of inadequate mixing with lipase containing digestive juices, whilst in the second instance the previous administration of fat caused the secretion of digestive juices which were mixed with the labeled triolein as it left the stomach. G. WALKER

The relationship between fat consumption and serum cholesterol levels has been reasonably well established. However, other factors have been demonstrated to influence serum lipid values, such as exercise, smoking, hormones and emotional states. The following papers introduce the problem of the effect of several variables upon serum cholesterol.

Clinical and Epidemiological Observations on the Influence of Fats in the Diet. F. J. Stare. *Food Technol.*, 13: 33, 1959.

The author reviews serum cholesterol data on 2,000 U. S. men with and without histories of myocardial infarction. Case histories, blood analyses and observations at autopsy are summarized on 200 Guatemalan men. Reported also are data on 290 Boston-Italians whose parents came from the Naples area. The author believes that the evidence is quite clear that the elevation of serum cholesterol levels has much to do with the problem of atherosclerosis, but that it is not the sole factor.

Serum cholesterol levels in "skinny people" averaged 223 mg. per 100 ml. in those really overweight—232 per 100 ml., and in those in the process of becoming overweight—243 mg. per 100 ml. It appears that the greater hazard is in those in the process of becoming overweight. A young man is described who stuffed himself with carbohydrate calories to the extent that he gained considerable weight. During this period, his fat and cholesterol intake was low (15 gm. and 50 mg., respectively, per day). However, his serum cholesterol level rose from 125 to 200 mg per 100 ml. Data are presented on other young men given a high intake of calories, fat and cholesterol, who were required to exercise sufficiently to keep from gaining weight. Under these conditions, there was no change in the cholesterol level. On the other hand, when the subject was on a similar excess dietary intake, but not exercising, the weight went up as did also the level of serum cholesterol.

In a feeding experiment with monkeys the protein intake was raised from 10 to 25 per cent, at the same time changed from a methionine-deficient protein to one of good quality (casein); intake of cholesterol and fat was kept constant. The serum cholesterol level fell from 600 mg. to 230 mg. per 100 ml. In a casein-feeding experiment using rats, other constituents of the diet being the same, it was found that 10 per cent casein was as effective as 20 per cent in holding down the serum cholesterol level. However, 5 per cent casein was not enough.

Higher serum cholesterol levels are shown to occur in subjects with hypertension and in those who have a family history of cardiovascular disease.

In addition to the factors discussed as being predisposing toward arteriosclerosis, the author would add excessive smoking. However, he believes it remains to be proved that stress and strain are important factors. Cerebral hemorrhage and stroke are so closely related to the condition of coronary heart disease as to lead the author to state that they "are the same for all practical purposes." FRANK E. RICE

Experimental Studies on Dietary Fats, Cholesterol and Atherosclerosis. J. Stamler. *Food Technol.*, 13: 50, 1959.

Failure to distinguish between the various types of arteriosclerosis, until about twenty years ago, led to criticism of animal experimentation in the field of atherosclerosis and the role of diet as a causative factor. Intensive experimentation in recent years has developed methodologies that make it possible to apply with confidence the results of animal experimentation to man. So far, the animal experimental evidence does not support the hypothesis that a dietary deficiency of the es-

sential fatty acids may be a causative factor in atherosclerotic disease, since the condition can be readily produced in chicks and rabbits by feeding cholesterol even in the presence of large amounts of high essential fatty acid (EFA), unsaturated vegetable oils. The author believes that in this respect man is not decisively exceptional and that "all these experimental facts cast serious doubt upon the speculation that atherogenesis is a resultant of EFA deficiency." Actually the apparent need for EFA may be a "relative, secondary, derivative deficiency due to dietary imbalance."

The author admits that there is evidence that hypercholesterolemia is aggravated by a diet low in good protein, low in methionine and deficient in certain vitamins and trace minerals. These facts lend support to the concept that a good over-all pattern of diet is important. However, the decisive nutritional aberration in the etiology of hypercholesterolemia and atherogenesis is a high fat intake, any fat—not excluding those high in essential fatty acids—and a high intake of cholesterol.

Experiments with animals have shown that atherosclerosis in the coronary vessels, once produced by a diet high in fat and cholesterol, can, within limits, be reversed by substituting a diet low in fat, and cholesterol. FRANK E. RICE

A decrease in glucose metabolism introduced by the feeding of dietary sources high in unsaturated fat content is an interesting observation which should be examined in both diabetic and non-diabetic human subjects.

Effect of Dietary Fats on Glucose Tolerance and Alloxan Diabetes. J. J. Barboriak and W. A. Krehl. *Am. J. Physiol.*, 195: 639, 1958.

Effects of certain animal and vegetable fats, i.e., lard, butter, corn oil, coconut oil, cottonseed oil, margarine and Crisco, on glucose tolerance and on the toxic and diabetogenic action of alloxan have been investigated in experiments on rats. Experimental diets, containing 61.2 per cent of the fats under test, were fed for six, seven, nine and thirty-six weeks and fourteen months, respectively. In two long term series, the hyperglycemia following the injection of glucose (1 gm. per kg. body weight, intraperitoneally) was more pronounced in groups fed margarine or Crisco diets than in those receiving lard or butter diets. In the short-term series, the difference between these two groups of fats in the increase of blood sugar levels was not significant. The adverse effects of alloxan were also influenced by the type of fat in the diet; in one series both the incidence of diabetes and the mortality rate were higher in the group receiving corn oil than in those receiving butter and coconut oils; in another series only the mortality rate was affected. AUTHORS

Both lipogenesis and carbohydrate metabolism appear to be depressed by the feeding of corn oil. The latter effect may be attributed to the use of the fatty acid as metabolic substrate while the former could be explained on the basis of reduced glucose oxidation necessary to provide reduced triphosphopyridine nucleotide (TPNH) necessary for the formation of fatty acid.

Regulation of Hepatic Lipogenesis. The Influence of Dietary Fats. R. Hill, J. M. Linazasoro, F. Chevallier and I. J. Chaikoff. *J. Biol. Chem.*, 233: 305, 1958.

Previous work from this laboratory has shown hepatic lipogenesis in rats is greatly reduced during fasting or during decreased intake of carbohydrate. In the present experiments, rats were fed synthetic isocaloric diets for three days, containing 0, 1, 2.5, 5, 10 or 15 per cent fat, the carbohydrate level being kept constant. Livers from rats given no fat had the highest capacity to convert acetate-1-C^{14} to fatty acids, while livers from rats fed 15 per cent fat lost about 90 per cent of their ability to incorporate acetate into fatty acids. Depressed liver lipogenesis was observed with as little as 2.5 per cent of fat in the diet. Hydrogenated and unhydrogenated vegetable oils and lard were equally effective. Lipogenesis was also depressed in liver from intact rats which were fed greater amounts of corn oil. Neither variations in dietary protein nor injections of insulin had any effect on lipogenesis, and total liver fatty acids and $C^{14}O_2$ recoveries were not affected by variations in dietary lipid. The authors suggest that ingestion of fat specifically inhibits lipogenesis, and that hepatic lipogenesis is more sensitive to fat in the diet than to carbohydrate. M. K. HORWITT

The clearing factor of plasma is a lipolytic enzyme described as a heparin-activated lipoprotein lipase. The clearing effect depends further upon the presence of albumin as a transport agent for the liberated fatty acids. There is evidence that a mucopolysaccharide component is an integral part of the enzyme.

Human Endogenous Plasma Lipemia Clearing Activity After Intravenous Fat Emulsions (Lipomul). H. Engelberg. *J. Appl. Physiol.*, 12: 292, 1958.

Observations were made on endogenous plasma lipemia clearing activity after intravenous injections of fat emulsions into human patients. Decrease in optical density of incubated plasma and a coconut oil substrate was the criterion for lipemia clearing activity. It was observed that the inhibitions characteristic of clearing factor and postheparin lipoprotein lipase were the same. Both increases and decreases in lipemic clearing activity were noted following intravenous fat emulsion. The *in vitro* levels of lipemia clearing activity are determined by the opposing effects of fat intake which increases and the clearing process which inactivates it.
M. J. OPPENHEIMER

Plasma Turbidity Changes and Electrocardiographic Alterations Induced by Alimentary Hyperlipemia in Anginal Patients Before and After the Administration of

Gastric Mucin. V. Rulli and B. Rossi. *Circulation*, 18: 400, 1958.

Ten patients with exertional angina, abnormal resting electrocardiogram and development of electrocardiographic alterations after ingestion of a fat meal were studied. Electrocardiograms were taken and plasma optical density was determined photometrically before and at hourly intervals for five hours after a fat meal consisting of 200 gm. of homogenized milk cream containing 40 per cent fat. Each experiment was repeated with the addition of 250 mg. of gastric mucin to the fat meal.

Plasma optical density began to rise one hour after the fat meal, attained its peak during the third hour and descended. This response was completely inhibited by gastric mucin, and plasma optical density actually decreased.

Only five of ten patients showed a reduction in the electrocardiographic changes following a fat meal when receiving gastric mucin. W. H. ABELMANN

Plasma-Clearing Effect of Gastric Mucin in Healthy and Atherosclerotic Subjects Under Basal Conditions. B. Rossi and V. Rulli. *Circulation*, 18: 397, 1958.

Five healthy subjects and ten patients with history of myocardial infarction or angina pectoris were studied. The optical density of plasma was determined photometrically before and at hourly intervals for four hours after oral administration of 250 mg. of gastric mucin.

A plasma clearing effect was demonstrated in both groups. The magnitude of the effect at the end of three hours was 30 per cent for the healthy subjects and 26 per cent for the atherosclerotic patients. The effect was not increased with time *in vitro* at room temperature, but otherwise resembled that of heparin.

W. H. ABELMANN

Based on studies by Siperstein, one can assume that when glycolysis is inhibited there is prompt activation of tissue lipases resulting in the release of depot fat from tissue depots.

Early Effect of "Total" Pancreatectomy on Fat Metabolism in the Rat. S. S. Chernick and R. O. Scow. *Am. J. Physiol.*, 196: 125, 1959.

Within two hours after "total" pancreatectomy in fasting rats, blood concentrations of glucose, ketone bodies and total lipids were significantly elevated. Blood ketone bodies and total lipids increased before the blood glucose reached diabetic levels. The increase in blood lipids was due largely to triglycerides and was accompanied by accumulation of fat in the liver and kidneys. When depleted of body fat prior to surgery, ketosis, hyperlipemia or fatty liver and kidneys did not develop in pancreatectomized rats. Repeated injections of insulin, started immediately after pancreatectomy, prevented development of diabetes. When insulin was given for the first time one day after pancreatectomy, blood glucose, ketone bodies and fats were lowered to normal fasting levels within three hours; when given for the first time two days after pancreatectomy, blood glucose and fats were reduced to normal levels whereas the ketonemia, although somewhat decreased, remained high. The rapid changes in blood ketone bodies are interpreted as evidence of a direct action of insulin on liver. The decreased effect of insulin on ketonemia in rats deprived of insulin for two days may indicate development of hepatic resistance to insulin. AUTHORS

Hormonal Effects on C^{14} Acetate Metabolism in the Human. A. R. Hennes and W. W. Shreeve. *Proc. Soc. Exper. Biol. & Med.*, 100: 246, 1959.

In vivo studies in man using acetate labeled with C^{14} in the methyl or carboxyl groups showed that carboxyl carbon was incorporated in expired carbon dioxide and plasma triglycerides and cholesterol to a greater extent than methyl carbon. The acute administration of prednisone decreased the specific activity of the expired carbon dioxide but did not change the values for plasma triglycerides and cholesterol. A patient with severe diabetes and another with lipoatrophic diabetes incorporated more $2C^{14}$ into plasma triglycerides and cholesterol than a normal subject, while patient with mild diabetes incorporated less than the normal subject.

G. WALKER

Origin of the *Trans* Fatty Acids in Human Tissue. P. V. Johnston, F. A. Kummerow and C. H. Walton. *Proc. Soc. Exper. Biol. & Med.*, 99: 735, 1958.

Trans fatty acids were found in concentrations of 1.5 to 6.8 per cent in the depot fat of women undergoing caesarean section but were not detected in placenta, liver from still born babies or preputial tissue from newborn babies. These findings are similar to those obtained in rats and suggest that *trans* acids are of dietary rather than endogenous origin. G. WALKER

Lipid Composition of Human Serum Lipoprotein Fraction with Density Greater than 1.210. G. B. Phillips. *Proc. Soc. Exper. Biol. & Med.*, 100: 19, 1959.

A lipoprotein of density greater than 1.210 was separated by ultracentrifugation from the serum of normal adults and was found to contain phospholipid and triglyceride but little or no cholesterol. Approximately 8 per cent of the serum total phospholipid and 50 per cent of the serum lysolecithin were present in this fraction. Lysolecithin accounted for about half the phospholipid present in the material. G. WALKER

ESSENTIAL FATTY ACIDS

The difficulty in determining the requirement for essential fatty acids in adult mammals lies in the fact that variable stores of linoleic and related acids are present in body fat. The essential nature of these acids has been demonstrated in all mammals studied including rat, guinea

pig, pig, dog, rabbit and man. The indicator of the deficiency state has been dermatitis associated with some degree of growth failure. The following investigations conducted upon human infants advance our knowledge of nutritional requirements and interrelationships of these substances.

Essential Fatty Acids in Infant Nutrition. I. Linoleic Acid Requirement in Terms of Serum Di-, Tri- and Tetraenoic Acid Levels. H. F. Wiese, A. E. Hansen and D. J. D. Adam. *J. Nutrition*, 66: 345, 1958.

From earlier experiments it was apparent that serum levels of the 2-, 3- and 4-double bond fatty acids are related to dietary intake of linoleic acid, di- and tetraenoic acids increasing with increasing intake of linoleic acid; and, conversely, serum trienoic acid is higher on a low intake of linoleic acid.

Twenty-one infants under one year of age were maintained on milk mixtures containing known and varying amounts of linoleic acid. Generally, each infant was continued on one mixture for a week then changed to another. Some were continued on the same regimen for a longer time. Four were breast-fed. The basic cow's milk mixtures were—skim, half-skim, evaporated milk, homogenized whole milk and special milk preparations, which contained fats other than milk fat. As a means for varying the content of linoleic acid, methyl and ethyl linoleate and trilinolein were used. Protein was calculated to comprise 15 per cent of the calories consumed in all diets. Data are compiled on 184 dietary periods.

As was expected from the earlier experiments, both skim and half-skim mixtures resulted in higher serum trienoic acid values than were observed in the infants who receive evaporated milk. At the same time, the di- and tetraenoic acid values were higher when evaporated milk was fed. Supplementation of the skim and half-skim mixtures with linoleic acid in the form of trilinolein to 1 per cent of the caloric intake (approximately that of evaporated milk), resulted in serum levels for di- and tetraenoic acids similar to those for evaporated milk, but only when the supplement was given as trilinolein. Linoleates were much less effective in altering the di- and tetraenoic acids of the serum than was the triglyceride form of linoleic acid, linolein.

The authors find that in evaporated milk feeding practice linoleic acid comprises about 1 per cent of the calories, and that at this intake level serum values for di-, tri- and tetraenoic acids are, respectively, 10.5 ± 1.3, 2.7 ± 0.8 and 7.4 ± 2.4 per cent of the total fatty acids. Clinical experience in feeding babies with evaporated milk formulas would justify the conclusion that such levels may be considered "normal." They find also that the linoleic acid intake from human milk is about 4 per cent of the total calories, and that serum values resulting are for di-, tri- and tetraenoic acids 23.7 ± 1.8, 0.6 ± 0.2 and 10.0 ± 1.1 per cent of the total fatty acids. The authors are inclined to conclude that these levels "may well be optimum." They suggest, however, that a dietary deficiency of linoleic acid may be indicated only when di- and tetraenoic acids in the serum run less than 5 per cent of total fatty acids, and trienoic acid more than 5 per cent. FRANK E. RICE

Essential Fatty Acids in Infant Nutrition. II. Effect of Linoleic Acid on Caloric Intake. D. J. D. Adam, A. E. Hansen and H. F. Wiese. *J. Nutrition*, 66: 555, 1958.

A relationship between dietary unsaturated fatty acids and utilization of calories has been recognized by others in young rats. This report presents data concerning the influence of dietary fat on caloric intake in healthy infants. Sixteen subjects two weeks to four months of age were given various cow's milk mixtures which included skim, half-skim, evaporated milk, a proprietary milk preparation in which vegetable fats were substituted for milk fat and a special mixture containing skim and evaporated milk, lard and Dextrimaltose. Determined and recorded were cal./kg./day of food consumed, weight increases and changes in serum unsaturated fatty acids.

The general trend of decreasing caloric intake with increasing amounts of linoleic acid in the diet is clearly demonstrated. For instance, twelve infants on a skim milk diet averaged an intake of 155 cal./kg./day: whereas, when linoleic acid was added to the diet at the rate of 1 per cent of total calories, three infants averaged a cal./kg. intake of 109. Still lower cal./kg. intakes are observed at higher levels of linoleic acid supplementation. In general, the low intake of linoleic acid did not affect the growth curves of the infants. However, the authors believe it possible that if the babies had been maintained for long periods (years) on low fat diets, effects on growth might be discernible. Dienoic acid in the serum remained low in the infants on low fat diets and rose sharply with an increased intake of linoleic acid. One infant observed first while receiving an evaporated milk formula (about 1 per cent of the calories as linoleic acid) was consuming 106 cal./kg./day. When changed to skim milk, his food intake at the end of four weeks had increased to 152 cal./kg./day. However, the weight gain was satisfactory throughout both periods. Two breast-fed infants who were consuming at the end of eight weeks 78 and 93 cal./kg./day were gaining weight. The linoleic content of the breast milk was about 4 per cent of the total calories. These subjects were found to have high serum dienoic acid levels. There appeared to be no difference in physical activity between the various groups of infants, regardless of caloric intakes.

The authors note that 1 per cent of total calories as linoleic acid is sufficient to bring about a food consumption of 106 to 109 cal./kg./day, which is within the range of caloric requirement usually given. This they consider "adequate." Inasmuch as a still higher linoleic acid intake level (as from human milk) results in a still lower cal./kg., the authors assume that "an intake in the neighborhood of 4 per cent of the calories as linoleic acid is more nearly optimum." FRANK E. RICE

Essential Fatty Acids in Infant Nutrition. III. Clinical Manifestation of Linoleic Acid Deficiency. A. E. Hansen, M. E. Haggard, A. N. Boelsche, D. J. D. Adam and H. F. Wiese. *J. Nutrition*, 66: 565, 1958.

This is a third report on the studies being made to evaluate the role of the essential fatty acids in infant feeding. Five different milk mixtures were given to healthy infants over a sufficient period of time for differences in clinical manifestations to be observable, varying from two weeks to twelve months. The groups receiving the milk mixtures practically devoid of, or extremely low in, fat had to be terminated before the others because of unsatisfactory progress in the infants. Dietary supplements used were linoleic acid as trilinolein, and as natural fat. Particular attention was given to growth, development, illnesses, the number and character of stools and condition of the skin; blood serum unsaturated fatty acid determinations were made by the method of alkaline isomerization.

Infants on low fat mixtures did not exhibit vomiting or regurgitation. Progress was generally satisfactory, including weight gains, except for some loose stools, perianal irritation and skin abnormalities. Low fat mixtures produced also low serum di- and tetraenoic fatty acids and high trienoic fatty acid. In some cases the introduction of solid foods made it possible to continue the infants longer on the low essential fatty acid diet. This was due in part to the appreciable amounts of linoleic acid in the cereals and in part to the fact as the infant becomes more mature his sensitivity to low fat is decreased. A definite correlation between the condition of the skin and the serum levels of unsaturated fatty acids was observed in a number of cases. Individual variations in the susceptibility of the skin to changes due to fat deficiency was indicated. Demonstrable skin changes developed in a larger proportion of Negroes than in those of American or Anglo-Saxon extraction.

Tripalmitin fed at 2 per cent of the caloric intake did not improve the condition of the skin, neither did saturated fats equal to 42 per cent of the calories. Whenever a milk mixture containing 1.3 per cent of the calories as linoleic acid was given, the skin returned to normal in two to four weeks. In one instance, arachidonic acid given as the ethyl ester at a 2 per cent caloric level required five weeks for the skin to return to normal. Administration of arachidonic acid was ineffective in increasing the dienoic acid level of serum. It is concluded that young infants require linoleic acid in their diet.

FRANK E. RICE

The amount of linoleate required to prevent dermatitis in the human infant is about 1 per cent of the total calories. In an adult the requirement should be less; however, the average American consumes nearly 4 per cent of his total calories as linoleate. On this basis the suggestion that atherosclerosis is due to EFA deficiency seems to be highly improbable.

The Effect on Human Serum Lipids of a Dietary Fat, Highly Unsaturated, but Poor in Essential Fatty Acids. E. H. Ahrens, W. Insull, J. Hirsch, W. Stoffel, M. L. Peterson, J. W. Farquhar, T. Miller and H. J. Thomasson. *Lancet*, 1: 115, 1959.

While it has been repeatedly shown that feeding of unsaturated fats reduces the serum level of cholesterol and phospholipids, the view is also held that this may be due to a deficiency of essential fatty acids. The question cannot be decided by feeding with natural animal or vegetable fats but in this experiment a marine oil—menhaden oil—has been used. Produced from the menhaden fish (*Brevoortia tyrannus*), the oil is highly unsaturated with an extremely poor essential fatty acid content. A detailed analysis is provided.

Two subjects, one with hyperlipemia and the other with hypercholesterolemia, were studied for twenty-one and twenty-two weeks in a metabolic ward; their weights were maintained at a constant level by diets containing 40 per cent of calories as fat, alternatively corn oil or menhaden oil. When menhaden oil was substituted isocalorically for corn oil, serum levels of cholesterol, phospholipids and triglycerides remained depressed. The fatty acid patterns of all three ester groups of the serum lipids were considerably affected by the strikingly different composition of the two dietary fats.

The effect on serum lipid levels was unrelated to the essential fatty acid and sterol contents of the two dietary fats, and it can be concluded that the presence of essential fatty acids is not required to lower the serum lipids.

F. E. HYTTEN

Evidence has accumulated to show that the bile acids are the chief means of cholesterol excretion in the animal.

Effect of Certain Dietary Oils on Bile Acid Secretion and Serum Cholesterol. B. Lewis. *Lancet*, 1: 1090, 1958.

It is now well known that serum cholesterol is raised by dietary fats of animal origin and lowered by many of the highly unsaturated vegetable oils.

In this paper an explanation for the phenomenon is offered. Three subjects with complete bile fistulas were given sunflower seed oil and cotton seed oil as highly unsaturated fats, and hydrogenated coconut oil as a saturated fat. Their bile acid secretion was studied. With the unsaturated fats there was a marked increase in the secretion of cholic acid which preceded the fall in serum cholesterol. The saturated fat did not affect bile acid output but raised the serum cholesterol level.

These findings support the hypothesis that the mechanism by which the serum cholesterol is reduced involves accelerated metabolism of cholesterol to cholic acid.

F. E. HYTTEN

Effects of Dietary Fat upon Polyunsaturated Fatty Acids of Blood in Patients with Multiple Sclerosis. B. Gerstl, W. E. Davis, J. K. Smith, E. Athineos and

G. Herold. *Proc. Soc. Exper. Biol. & Med.*, 100: 534, 1959.

Earlier work showed that some patients with multiple sclerosis have unusually high concentrations of plasma dienoic acids. It is well known that the plasma fatty acids reflect those of the diet to some extent. The effect on plasma fatty acids of feeding a diet rich in polyunsaturated fatty acids was studied in three patients with multiple sclerosis and in three normal subjects. The experimental diet provided 31 gm. monoenoic, 64 gm. dienoic and 6 gm. trienoic fatty acids, from soy oil and a lecithin preparation.

The plasma cholesterol and tetraenoic acid decreased and the dienoic acid increased equally in the two groups. The trienoic acid concentration was unchanged in the patients but fell in the control subjects. No changes were detected in the fatty acids of the red cells in either group. G. WALKER

The feeding of corn oil or other sources of polyunsaturated fatty acids has been shown to increase cholesterol anabolism by increasing the rate of incorporation of acetate into hepatic cholesterol.

Aggravation of Cholesterol Atherosclerosis in Rabbits by Unsaturated Fatty Acids. G. Rona and R. Gaudry. *Proc. Canad. Fed. Biol. Soc.*, 1: 42, 1958.

The effect of unsaturated fatty acids on hypercholesterolemia and atherosclerosis was tested in rabbits. Three times a week for six weeks the animals received by stomach tube 0.5 gm./kg. cholesterol dissolved in a mixture of 90 to 95 per cent linoleic acid, 4 to 5 per cent oleic acid and 2 to 3 per cent saturated C_{18} acids. Control animals received cholesterol dissolved in olive oil. A markedly higher hypercholesteremia and a more severe degree of atherosclerosis developed in the test rabbits than in the control animals. These findings seem to contradict results by earlier authors which indicated that vegetable oils containing unsaturated effect might have favorable effects on serum cholesterol and lipid levels when given to subjects with hypercholesteremia or hyperlipemia. M. SILBERBERG

Effects of Saturated and Unsaturated Fat on Cholesterol Metabolism in the Rat. J. Avigan and D. Steinberg. *Proc. Soc. Exper. Biol. & Med.*, 97: 814, 1958.

Adult rats given corn or coconut oil supplements ate more and had higher serum cholesterol levels than control animals fed only the same basic diet. The serum cholesterol level was lower in animals receiving corn oil than in animals receiving the same amount of coconut oil.

Coconut oil was without effect, while corn oil and linoleic acid, with or without mixed corn oil sterols, increased the amount of esterified cholesterol in the liver.

Studies with C^{14} acetate and H_2O^3 *in vivo* and with liver slices from treated animals, incubated *in vitro*, showed that coconut oil had no effect on, while corn oil increased, the rate of production of non-saponifiable lipid extracted from serum, liver and adrenal tissue. G. WALKER

Essential fatty acid (EFA) deficiency leads to biochemical changes which may account for certain gross and microscopic pathologic lesions. Inversion of the diene/triene ratio in skin, testes and heart muscle precedes the morphologic changes. The effect of EFA deficiency upon the mitochondria may occur as a result of alterations in lipoprotein and phospholipid structure.

Essential Fatty Acids as Food Supplements. E. Aaes-Jørgensen. *J. Agr. Food Chem.*, 7: 246, 1959.

The syndrome caused by a dietary deficiency of essential fatty acids (EFA) as it appears in rats is described in detail. Recorded also are the present day theories as to conversions of unsaturated fatty acids metabolically one into another.

EFA deficiency symptoms can be accentuated by feeding highly unsaturated non-essential fatty acids. The effect is even greater than when the animal is on a fat-free diet. Some investigators have observed that feeding margarine can accentuate the EFA deficiency symptoms. This effect may be due to the presence of unsaturated non-essential fatty acids in margarine and other hydrogenated fats, although it may be also that certain geometric isomers of the unsaturated acids, known to be produced by hydrogenation, are responsible for the intensification of the EFA deficiency syndrome, when fats containing hydrogenated oils are fed. It has been generally observed also that on an EFA deficient diet, while the animal tissues decrease in the essential fatty (dienoic) acids, there is a simultaneous increase in the tissues of the non-essential trjenoic acid.

It is difficult to produce EFA deficiency symptoms in adult rats. Presumably the body reserves provide the small amount that is needed after growth ceases. Studies to determine what purpose EFA serves in animal metabolism have yielded little positive information. It is known that ingested linoleate soon appears as phospholipids, which in turn have an important transport function, e.g., in transporting cholesterol. Note that the inclusion of cholesterol in an EFA-free diet hastens the appearance of skin signs of EFA deficiency.

The author concludes that the findings reported so far are rather controversial as to the effect of the various fatty acids upon hypercholesterolemia and atherosclerosis. FRANK E. RICE

Essential Fatty Acid Activities of Hydrocarbons and Alcohols Analogous to Linoleate and Linolenate. E. Aaes-Jorgensen, O. S. Privett and R. T. Holman. *J. Nutrition*, 67: 413, 1959.

EFA (essential fatty acid) activity thus far has been found to be fully exhibited by linoleic acid and its esters, linoleyl alcohol, and arachidonic acid and its esters. These have in common the first double bond between

carbon atoms numbers 6 and 7, counting from the terminal methyl group. Polyunsaturated fatty acids with the first double bond at the third carbon atom, as in linolenic acid, stimulate growth, but do not maintain dermal integrity as does the linoleic acid family. This study was undertaken to test the EFA activity of hydrocarbons and alcohols analogous to linoleate and linolenate to learn if the carboxyl function is necessary for activity. The following were prepared for the study: (1) ethyl linoleate; (2) linoleyl alcohol; (3) linolenyl alcohol; and the hydrocarbon analogues of linoleic and linolenic acids, (4) octadecadiene and (5) octadecatriene.

Weanling rats were prepared for testing by maintaining them on a fat-free diet for eleven weeks, at which time the growth curve was approaching a plateau and distinct dermal symptoms had appeared. The substances to be tested were fed beginning at this time at the rate of 200 mg. per rat thrice weekly. Polyunsaturated fatty acid analyses were carried out on the lipids extracted from the heart and testes.

Only substances (1) and (2) relieved all the symptoms of EFA deficiency. Product (3) stimulated growth but did not markedly decrease the dermal symptoms. Alcohols (2) and (3) induced changes in the polyunsaturated fatty acid content of heart tissue similar to those induced by the corresponding acids. The hydrocarbons, (4) and (5), had such strong irritant effect as to obscure any EFA activity that could have resulted from feeding.

FRANK E. RICE

Essential Fatty Acid Deficiency. II. In Adult Rats. E. Aaes-Jørgensen, E. E. Leppik, H. W. Hayes and R. T. Holman. *J. Nutrition*, 66: 245, 1958.

The aim of this study was to induce EFA (essential fatty acid) deficiency in adult rats by feeding an EFA-free diet and to compare the effects of cholesterol and cholic acid alone, or in combination, as causes of stress. Forty-seven adult male rats were used. Low fat, EFA-free diets were fed to some groups; others received the same ration supplemented with 1 per cent cholesterol, or, 0.5 per cent cholic acid, or, a combination of the two. In the second part of the project, after twenty-three weeks on these diets, cholesterol and cholic acid were withdrawn from the rations, and 20 per cent hydrogenated coconut oil incorporated.

The onset of dermal symptoms of EFA deficiency in these rats was late in comparison with the usual nine to twelve weeks required by weanling rats on similar diets. Cholic acid moderately hastened the appearance of the dermal symptoms, but cholesterol did not. Neither had much effect upon the severity of the symptoms. Histologic examinations were made of the tissues of various organs including heart, kidney, testes, liver and coronary arteries. Polyunsaturated total fatty acid content of the testes showed little difference between the groups, but in all groups the content of trienoic acid was several times the content of dienoic acid. Cholesterol and cholic acid supplements doubled the amount of trienoic acid in the heart from which it is judged that these supplements do act as stresses and intensify an EFA deficiency. Lipid deposits in the coronary arteries of some of the groups of animals were found after twenty-nine weeks. Some of these groups of animals also had high plasma cholesterol levels.

Feeding 20 per cent hydrogenated coconut oil in the second period increased the dienoic acid and somewhat decreased the trienoic acid content of heart tissue. From this and other observations it is concluded that the hydrogenated coconut oil in some way spares the polyunsaturated acid metabolism. The high content of this oil in medium chain fatty acids may provide an explanation, for these are known to have nutritional effects different from long chain saturated acids.

A number of factors lead the authors to the conclusion that dermal symptoms cannot alone be used as an accurate indicator of the status of EFA deficiency. The experimental data indicate that the increase of the trienoic acid in the tissues is the best evaluation of EFA deficiency and the status of the animal.

FRANK E. RICE

Nutritional Studies with the Guinea Pig. V. Effects of Deficiency of Fat or Unsaturated Fatty Acids. M. E. Reid and M. G. Martin. *J. Nutrition*, 67: 611, 1959.

The purpose of this study was to determine the effects of fat deficiency on the organs and body of the guinea pig. Purified diets were fed—(1) without any fat and (2) with 7.3 per cent of corn oil.

Seven tests with six to ten animals each were conducted with both the fat deficient and control diets. The caloric value of the no fat ration was adjusted by varying the amount of the glucose. The carbohydrate portion of the ration was made up of glucose 15.1 per cent, sucrose 10.3 per cent and cornstarch 20 per cent. The protein used was casein.

The authors report in detail the morphologic and chemical differences between the animals, on the two contrasting diets. Fat deprivation caused little, if any, increase in water consumption in the guinea pig. In this respect this animal reacts differently from the rat, which increases its water consumption two to three times on a fat deficient diet. This species difference is believed to be due to the less extensive skin changes produced in the guinea pig on such a diet. In the rat, there may be a greater water loss through the skin.

FRANK E. RICE

ITEMS OF GENERAL INTEREST

Lactose in Animal and Human Feeding: A Review R. L. Atkinson, F. H. Kratzer and G. F. Stewart. *J. Dairy Sci.*, 40: 1114, 1957.

This is a thorough review of the literature on the subject, including 101 references. In addition to the energy value of lactose, it has many unique properties advantageous in human and animal nutrition. Because of its slow digestion and absorption, lactose reaches a much lower portion of the large intestine than other sugars. In consequence, it encourages intestinal

flora of an acidophilic type, promotes a predominating bifidum flora found in infants fed human milk, relieves disorders in children associated with a putrefactive intestinal flora, stimulates gastrointestinal motility, favors the utilization of calcium, phosphorus and magnesium, and stimulates the synthesis of B vitamins by the intestinal flora.

In numerous animal experiments in which lactose has been compared with other carbohydrates, fed in normal diets and also in excessive amounts, the following have been observed as indications of favorable physiologic effects derived from lactose: (1) appears to have a favorable influence on fat metabolism and on reproductive capacity; (2) has a choline-sparing and lipotropic action; (3) better protects the rat against alloxan poisoning than other carbohydrates; (4) when fed in excess, it is better tolerated than other carbohydrates especially in younger mammals. Galactose, the monosaccharide moiety peculiar only to lactose, has specific functions in the development of the central nervous system. The problem-solving ability of rats has been shown to be improved by lactose.

Lactose cataract in rats fed high levels of lactose has been observed by different workers. This phenomenon is still a mystery. Research in this field should be extended, as it might throw light on the causes of other types of cataract. The author believes that all evidence points to the conclusion that lactose should be the carbohydrate of choice in the infant feeding formula.

FRANK E. RICE

Emotional State and Energy Expenditure. P. H. Melville and A. G. Mezey. *Lancet*, 1: 273, 1959.

Emotional disturbance has always been regarded as an influence which raises the basal metabolic rate, and measurement of the basal metabolic rate during induced sleep has been recommended recently.

In this experiment thirty-two psychiatric patients and ten control subjects had their oxygen consumption measured in lying, sitting and standing positions. All had normal serum protein-bound iodine values and were taking no medication. In the psychiatric patients, the psychologic state varied from "practically normal" in an alcoholic to "very severe delusional fear;" they were rated subjectively on their symptoms but the exact basis for the rating is not defined.

Quite unexpectedly, the mean oxygen consumption in the disturbed patients was no different from that in the control subjects in any of the three positions; nor was there any relationship between the oxygen consumption and the degree of emotional disturbance.

The only odd finding was that many of the severely disturbed patients showed a diminished oxygen consumption when standing.

F. E. HYTTEN

Effect of Banana Ingestion on Urinary Excretion of 5-Hydroxyindole Compounds in Normal Adults. G. A. Puente-Duany, W. E. Reimer and J. B. Miale. *Proc. Soc. Exper. Biol. & Med.*, 98: 499, 1958.

The twenty-four hour urinary 5-hydroxyindoleacetic acid output of ten normal adults was approximately doubled by feeding 12 gm. of peeled banana per kg. body weight in divided amounts throughout the day. It is unlikely that this modest increase of 5-hydroxyindoleacetic acid excretion would interfere with the laboratory diagnosis of malignant carcinoid. These results in adults contrast with the much greater changes in children and monkeys reported by other workers.

G. WALKER

Elevated Vitamin Levels in Cerebrospinal Fluid in Multiple Sclerosis. H. Sobotka, N. Christoff and H. Baker. *Proc. Soc. Exper. Biol. & Med.*, 98: 534, 1958.

The concentration of total (free and conjugated) folic acid was greater than normal in the cerebrospinal fluid and serum of thirty-four of forty-two patients with multiple sclerosis. Cerebrospinal fluid and serum vitamin B_{12} levels were increased in fourteen of forty-one of the same patients.

It is suggested that these abnormalities could affect enzyme activity in the central nervous system, and could be related to the cause rather than the effects of the disease.

G. WALKER

International Survey of Clinical Chemistry Procedures. E. W. Rice. *Clin. Chim. Acta*, 3: 121, 1958.

The results of an explanatory letter and questionnaire sent to 450 medical schools and affiliated hospital laboratories throughout the world are summarized. Unfortunately only 21.1 per cent replied to the request to record the particular procedures used in his clinical laboratory for the routine determination of indicated constituents of blood. The more popular methods were found to be the old "time-honored" procedures of Folin, Wu, Benedict, Van Slyke, Myers, Somogyi, Bloor and others. However, the results of the survey suggested an ominous reluctance to adopt some of the newer and improved procedures. The author prepared a list of more recent methods that in his experience meet criteria of ideal analytical procedure.

They include the following: Amylase (Van Loon), bilirubin (Stoner and Weisberg), calcium (Humoller and Walsh), chloride (modified Schales and Schales), cholesterol (Zak et al.), creatinine (Hare), glucose (Nelson-Somogyi), hemoglobin (Crosby et al.), nonprotein nitrogen (not recommended; preference for urea determination), phosphatase-alkaline-acid (Bessey et al.; Andersch and Szczypinski), phosphorus (Taussky and Shorr), serum protein and fractions (Reiner), urea (Annino), uric acid (Caraway). Although some clinical biochemists may disagree with the author's recommendations, the survey and accompanying 115 references will be of value to investigators selecting and standardizing bioanalytical methods.

E. COHEN

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Clinical Nutrition

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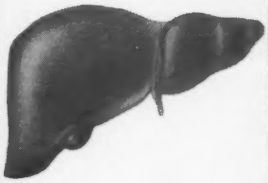

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Papers from the Department of Nutrition, Vanderbilt University School of Medicine

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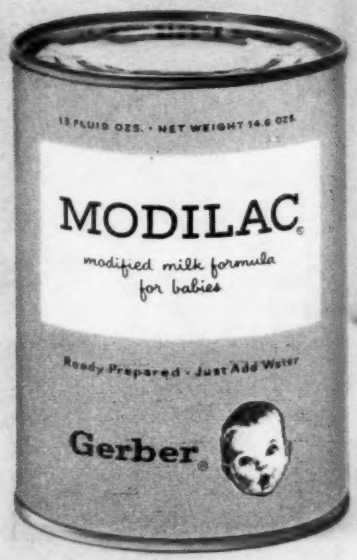

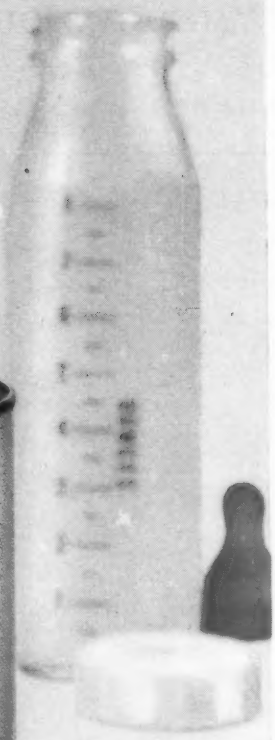

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One of the major problems in clinical nutrition is the assessment of deficiency. Among preschool children protein and caloric deficits are found worldwide. This significant paper analyzes and evaluates such criteria as vital statistics, anthropometric measurements, and clinical, laboratory and dietary data as indicators of malnutrition. There are important implications here for pediatricians, public health workers and others concerned with clinical evaluation.

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One of the concomitants of clinical scurvy is amino-aciduria. This observation is based largely on pediatric cases. In this concise paper a case of scurvy in a seventy-three year old man is described. Using a simplified chromatographic technic the authors studied the changes in the pattern of urinary amino acids during the patient's rapid response to therapy. This report has both clinical and laboratory aspects of considerable interest.

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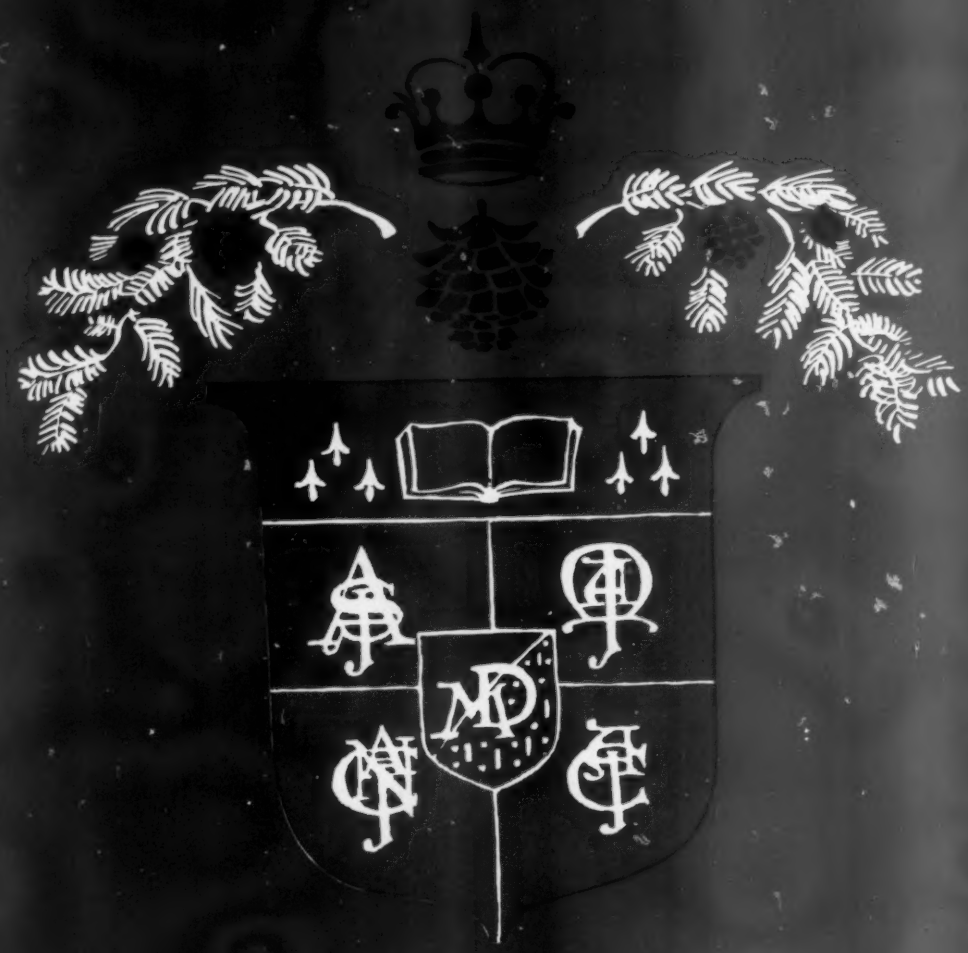

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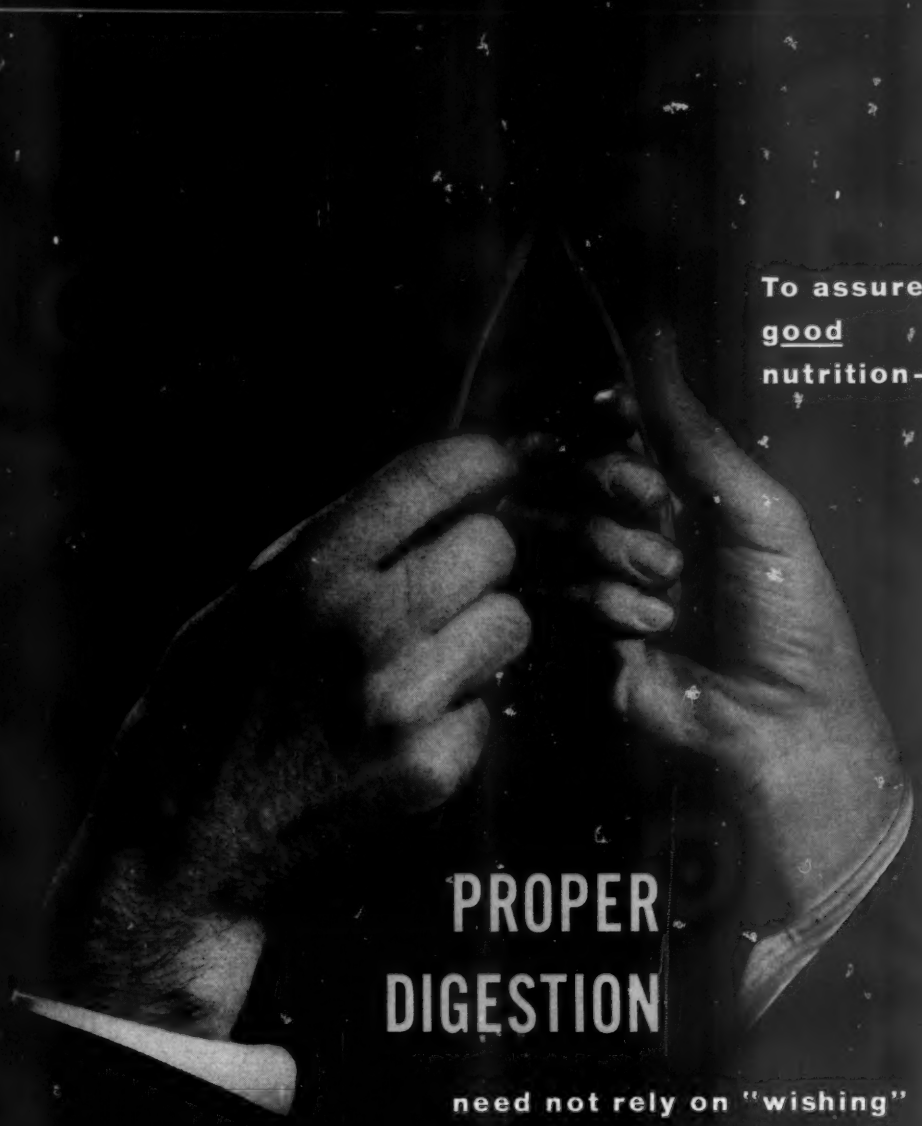

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This fall, teen-age boys and girls in every state must pass this simple nutrition quiz to qualify for participation in the National Youthpower Congress next February 11-12-13 in Chicago. The Congress is planned to foster greater public understanding of the cultural, economic and nutritional values of food. We thought you might enjoy checking this quiz yourself. (The answers are shown below.)

Question 1.

How do you define nutrition? (CHECK ONE)

a. ☐ Selection of foods good for you.
b. ☐ Digestion of food.
c. ☐ Study of foods in relation to health.
d. ☐ Knowledge of what foods are good and what foods are bad for you.

Question 2.

What is a vitamin? (CHECK ONE)

a. ☐ Something added to make food taste better.
b. ☐ An organic substance required in minute amounts for the health of the body.
c. ☐ What some foods contain to make you grow and provide energy.
d. ☐ A special class of food.

Question 3.

Basic classes of foods include: (CHECK FOUR)

a. ☐ Milk and dairy products
b. ☐ Proteins
c. ☐ Fruits and vegetables
d. ☐ Fats
e. ☐ Trace elements
f. ☐ Minerals
g. ☐ Starch
h. ☐ Vitamins
i. ☐ Whole grain, enriched or restored cereals and breads
j. ☐ Meat, fish, eggs, beans and nuts

Question 4.

Match the functions in the column at the left to the items in the right column that perform these functions. (MARK LETTERS IN SQUARES)

a. Warmth and energy
b. Growth and repair
c. Bone structure and body regulation
d. Blood formation

1. ☐ Fats and carbohydrates
2. ☐ Calcium, phosphorus and other minerals
3. ☐ Proteins
4. ☐ Iron

Question 5.

True or false? (MARK T OR F IN SQUARES)

1. ☐ Today's population in America is the best fed in history.
2. ☐ The amount of food you need depends on your age, sex and activities.
3. ☐ Eating a balanced diet is expensive.
4. ☐ A good diet should include milk products; meat; fish or eggs; fruit and vegetables; breads and cereals.
5. ☐ An overweight person is malnourished.
6. ☐ No one food supplies all the nutrients we need.
7. ☐ We all need vitamin supplements to be well nourished.
8. ☐ Sirloin is more nourishing than hamburger.
9. ☐ Your most desirable weight is about what you weigh in good health between ages 25-30.
10. ☐ People in the same family, eating the same meals all show the same signs of good or poor diet.
11. ☐ Growing heavier as we grow older is a sign of good health.

Question 6.

Listed below are essential nutrients marked 1 to 9. Each of the foods listed supply one or more of these nutrients in generous amounts. (MATCH THE NUMBERS TO THE FOODS)

1. Vitamin C
2. Protein
3. Calcium
4. Thiamine
5. Iron
6. Vitamin A
7. Vitamin D
8. Niacin
9. Riboflavin

A._____ Cod Liver Oil
B._____ Cottage Cheese
C._____ Cantaloupe
D._____ Nuts
E._____ Enriched bread
F._____ Fortified whole milk
G._____ Butter and fortified margarine
H._____ Meat
I._____ Dry beans
J._____ Eggs
K._____ Oranges

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and whole wheat flour foods are listed among the "Essential Four" food groups set up by the U. S. Dept. of Agriculture's Institute of Home Economics. Diet selected from these foods provides ample protein, vitamins and minerals.

Answers: Q1 (c)...Q2 (b)...Q3 (a, c, i, j)...Q4 (1a, 2c, 3b, 4d)...Q5 (1T, 2T, 3F, 4T, 5T, 6T, 7F, 8F, 9T, 10F, 11F)...Q6 (A. 6, 7—B. 2, 3, 9—C. 1, 6—D. 2, 8—E. 3, 4, 5, 8, 9—F. 2, 3, 6, 7, 9—G. 6—H. 2, 4, 5, 8, 9—I. 2 ,5—J. 2, 3, 6—K. 1

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moderate low-fat and well-balanced food values in cereal and milk serving

Among breakfast main dishes, the cereal and milk serving merits consideration when a reduction of dietary fat is indicated because ***it ranks low in fat and provides well-balanced food values.*** **Few foods at such small cost can better its moderate low-fat, well-balanced nutritional contribution as shown in the table below. Served with nonfat milk, the fat content is very low.***

nutritive composition of average cereal serving

	Cereal, 1 oz. Whole Milk, 4 oz. Sugar, 1 teaspoon	Cereal** 1 oz.	Whole Milk 4 oz.	Sugar 1 teaspoon
CALORIES	203	104	83	16
PROTEIN	7.3 gm.	3.1 gm.	4.2 gm.	
FAT	5.3 gm.	0.6 gm.	4.7 gm.*	
CARBOHYDRATE	32.2 gm.	22 gm.	6.0 gm.	4.2 gm.
CALCIUM	0.169 gm.	0.025 gm.	0.144 gm.	
IRON	1.5 mg.	1.4 mg.	0.1 mg.	
VITAMIN A	195 I. U.	—	195 I. U.	
THIAMINE	0.16 mg.	0.12 mg.	0.04 mg.	
RIBOFLAVIN	0.25 mg.	0.04 mg.	0.21 mg.	
NIACIN	1.4 mg.	1.3 mg.	0.1 mg.	
ASCORBIC ACID	1.5 mg.	—	1.5 mg.	
CHOLESTEROL	16.4 mg.	0	16.4 mg.*	

*Nonfat (skim) milk, 4 oz., reduces the Fat value to 0.1 gm. and the Cholesterol value to 0.35 mg.
**Based on composite average of breakfast cereals on dry weight basis.

Cereal Institute, Inc.: Breakfast Source Book. Chicago: Cereal Institute, Inc., 1959.

Hayes, O. B., and Rose, G. K.: Supplementary Food Composition Table. J. Am. Dietet. A. 33:26, 1957.

Watt, B. K., and Merrill, A. L.: Composition of Foods-Raw, Processed, Prepared. U.S.D.A. Agriculture Handbook No. 8, 1950.

CEREAL INSTITUTE, INC.
135 South La Salle Street, Chicago 3

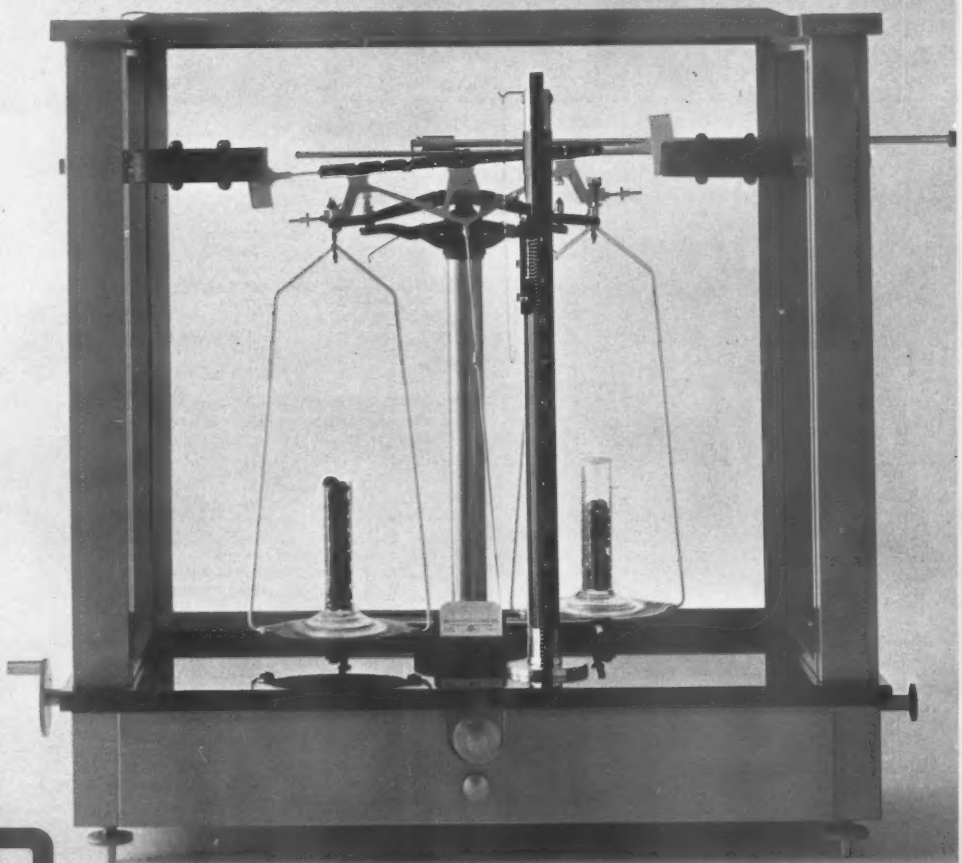
A research and educational endeavor devoted to the betterment of national nutrition

WHAT MAKES ABBOTT VITAMINS SO SMALL?

Take this Dayalets-M® for example. It contains nineteen ingredients—10 important vitamins plus nine valuable minerals. Yet it's no larger than a Spanish peanut—easily the most compact tablet of its kind. Likewise with the Abbott vitamins listed on the next page.

Secret? One word. Filmtab®. Microscopically thin, this ingenious tablet coating (an Abbott exclusive) cuts the tablet weight as much as one half, reduces bulk up to a third.* Small point perhaps—but a nice one for your patient. The coating also seals out vitamin taste and odor—and resists chipping and deterioration. All of these things make Abbott vitamins just a little easier to take—a little pleasanter to keep on the table.

**When compared to some sugar-coated tablets. Below: 25 sugar-coated Dayalets-M on left pan of scale; 25 Filmtab Dayalets-M on right. Note the difference in volume and weight.*



ABBOTT

And only Abbott offers a full line of multivitamins in "table bottles" —at no extra cost to your patient (see other side).

®FILMTAB—FILMTAB-SEALED TABLETS; ABBOTT; U.S. PAT. NO. 2,801,060 9110266

VITAMINS BY ABBOTT

IN THE EXCLUSIVE FILMTAB COATING, WHICH CUTS THE SIZE . . .
IN THE ABBOTT "TABLE BOTTLES" WHICH HELPS THEM REMEMBER

PRODUCT AND HOW SUPPLIED	FORMULA/DOSAGE	DESCRIPTION
filmtab **DAYALETS®** Table bottle (100's); bottles of 50 & 250	each Filmtab **DAYALETS** represents: Vitamin A ..... 3 mg. (10,000 units) Vitamin D ..... 25 mcg. (1000 units) Thiamine Mononitrate ..... 5 mg. Riboflavin ..... 5 mg. Nicotinamide ..... 25 mg. Pyridoxine Hydrochloride ..... 2 mg. Vitamin B_{12} (as cobalamin concentrate) ..... 2 mcg. Folic Acid ..... 0.25 mg. Calcium Pantothenate ..... 5 mg. Ascorbic Acid ..... 100 mg. **Dosage:** Just one Filmtab daily for prophylaxis; two or more daily for therapeutic effect.	Two extra-potent maintenance formulas; ideal for those who are "run-down" nutritionally, or as prophylaxis for those on a restricted diet.
filmtab **DAYALETS-M®** Apothecary bottles, 100 & 250.	each **DAYALETS-M** represents all of Dayalets' vitamins, plus the following: Iron (as sulfate) ..... 10 mg. Copper (as sulfate) ..... 1 mg. Iodine (as calcium iodate) ..... 0.15 mg. Cobalt (as sulfate) ..... 0.1 mg. Manganese (as sulfate) ..... 1 mg. Magnesium (as oxide) ..... 5 mg. Potassium (as sulfate) ..... 5 mg. Zinc (as sulfate) ..... 1.5 mg. Molybdenum (as sodium molybdate) ..... 0.2 mg. **Dosage:** One Filmtab daily for prophylaxis; in more severe deficiencies, more may be prescribed.	
filmtab **OPTILETS®** **OPTILETS-M®** Table bottles of 30 and 100. Bottles of 50 and 1000.	Each **OPTILETS** Filmtab represents: Vitamin A ..... 7.5 (25,000 units) Vitamin D ..... 25 mcg. (1000 units) Thiamine Hydrochloride ..... 10 mg. Riboflavin ..... 5 mg. Nicotinamide ..... 100 mg. Pyridoxine Hydrochloride ..... 5 mg. Folic Acid ..... 0.3 mg. Vitamin B_{12} (as cobalamin concentrate) ..... 6 mcg. Calcium Pantothenate ..... 20 mg. Ascorbic Acid ..... 200 mg. **Dosage:** One or two Filmtabs daily, as directed by physician.	Therapeutic formulas for the more severe deficiencies—excellent for use when bodily stresses and requirements are increased, as in periods of illness or infection.
	each **OPTILETS-M** represents all the vitamins of Optilets, plus the following: Iron (as sulfate) ..... 10 mg. Copper (as sulfate) ..... 1 mg. Iodone (as calcium iodate) ..... 0.15 mg. Cobalt (as sulfate) ..... 0.1 mg. Manganese (as sulfate) ..... 1 mg. Magnesium (as oxide) ..... 5 mg. Potassium (as sulfate) ..... 5 mg. Zinc (as sulfate) ..... 1.5 mg. Molybdenum (as sodium molybdate) ..... 0.2 mg. **Dosage:** One or two Filmtabs daily, as directed by physician.	
filmtab **SUR-BEX® with C** Table bottle of 60. Bottles of 100, 500 and 1000.	each **SUR-BEX WITH C** Filmtab represents: Thiamine Mononitrate ..... 6 mg. Riboflavin ..... 6 mg. Nicotinamide ..... 30 mg. Pyridoxine Hydrochloride ..... 1 mg. Vitamin B_{12} (as cobalamin concentrate) ..... 2 mcg. Calcium Pantothenate ..... 10 mg. Ascorbic Acid ..... 150 mg. Desiccated Liver, N.F. ..... 300 mg. Brewer's Yeast, Dried ..... 150 mg. **Dosage:** As a dietary supplement, 1 or 2 Filmtabs daily; in convalescence, 2 or more Filmtabs daily.	The complete B-complex formula with a therapeutic amount of ascorbic acid . . . especially useful during such periods as postoperative recovery when the water soluble vitamins can be rapidly depleted.

New *self-enriched* Carnation Instant

25% more protein, calcium, B-vitamins, richer flavor than ordinary nonfat milk

New Carnation Instant can give your patients a *more delicious* nonfat milk—*extra-rich* in natural milk calcium, protein and B-vitamins. This new fresh flavor crystal-form nonfat milk can be *self-enriched.* The patient simply adds one extra spoonful of crystals per 8-oz. glass when mixing—to gain 25% more calcium, protein and B-vitamins than ordinary nonfat milk—and far richer flavor. Convenience and low cost also encourage acceptance. Calorie count remains low (400 per quart), facilitating weight control.

In examining the chart, physicians will recognize the particular value of the increase in natural milk calcium, more effectively utilized than most medicinal calcium salts.

	Calcium	Protein	Riboflavin	Thiamine
National Research Council Recommended Daily Dietary Allowances During Second Half of Pregnancy	1.5 Grams	78.0 Grams	2.0 Mg.	1.3 Mg.
Amount and Percent of Daily Dietary Allowances Provided by 1 Quart of 25% self-enriched Carnation Instant	1.48 Grams (98%)	41.3 Grams (53%)	2.26 Mg. (113%)	.40 Mg. (30%)

25% self-enriched Carnation Instant
Simply add 1 tablespoon extra Carnation Instant per glass, or 1/3 cup extra Carnation Instant per quart, over regular package directions.

BECOTIN® WITH VITAMIN C supplies needed and easily depleted water-soluble vitamins

"Fever . . . increases vitamin requirements. This is especially true of the B complex and C vitamins. Liquid and soft diets, which are commonly prescribed early in disease, are inadequate in these vitamins."[1] These observations lead to the conclusion that any patient with a prolonged infection will enjoy faster, smoother convalescence when the diet is liberally supplemented with water-soluble vitamins.

Becotin with Vitamin C provides therapeutic amounts of the water-soluble B complex and ascorbic acid plus all the vitamins naturally occurring in desiccated liver and stomach tissue. Prescribe 1 to 3 Pulvules® daily according to the severity and length of illness; reduce dosage as patient improves.

1. Pollack, H., and Halpern, S. L.: Therapeutic Nutrition, Publication No. 234, p. 54. Washington, D. C.: National Academy of Sciences, National Research Council, 1952.

Becotin® with Vitamin C (vitamin B complex with vitamin C, Lilly)

LILLY VITAMINS . . . "THE PHYSICIAN'S LINE"

WHY SHOULD THE VITAMIN C CONTENT OF FRUIT AND VEGETABLE JUICES BE STANDARDIZED?

Because nutrition reports disclose that —

- **Vitamin C deficiencies exist throughout the country***
- **Scurvy has not disappeared from the United States***

Proof of deficiencies among adults and children. You should know these facts!* Diet surveys from Maine and Vermont, New York, Illinois, New Mexico, Oregon, West Virginia, and Texas show a definite pattern of inadequate vitamin C intake. These studies covered grade school and high school children, college men and women.

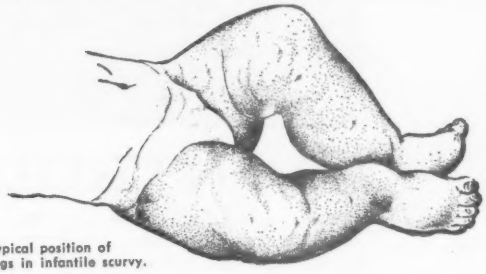
Spongy, swollen gums symptomatic of scurvy.

From these studies* of dietary habits and physical conditions there is considerable proof that many of the children and adults covered by survey have actual, physical symptoms of vitamin C deficiency.

Infantile scurvy. Scurvy* occurs, even today, among infants who are artificially fed. Fortunately the disease may be cured by the administration of vitamin C. How much more sensible it is to prevent it by supplying these bottle-fed infants with the daily allowance of 30 milligrams of vitamin C as recommended by the Food and Nutrition Board of the National Research Council for children under one year of age.

Symptoms of infantile scurvy are fretfulness and fear of being touched.

These bottle-fed infants, unless receiving a pediatric prescription containing vitamin C, are largely dependent on supplemental ascorbic acid which they receive from fruit or vegetable juices. Unless fortified with vitamin C many of the processed juices may not supply these babies with adequate quantities of this essential element.



Typical position of legs in infantile scurvy.

What can be done? Because of the increasing evidence that American diets are deficient in vitamin C, leading nutrition experts believe that processed fruit and vegetable juices, on which the public is so reliant for its supply of this necessary vitamin, should contain the "Vital Ingredient."

The Vital Ingredient of any processed fruit or vegetable juice is a *dependable* and *adequate* supply of vitamin C. You can give your juice this ingredient by *standardizing its vitamin C content*. The processing is simple and the new low cost of ascorbic acid makes juice standardization more attractive than ever.

With ascorbic acid available *by the tons* at extremely modest cost fruit and vegetable juices can have a standardized vitamin C content for the better protection of the nation's health and well-being.

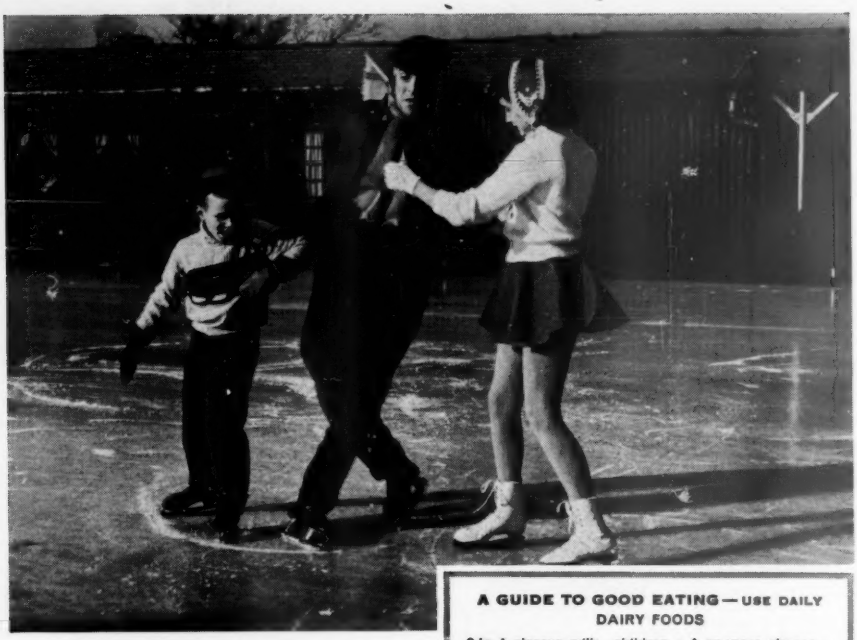
*Statements are based on documented reports. References on request.

Illustrations after photographs in The Vitamins in Medicine by Bicknell and Prescott, Third Edition, published by Grune & Stratton, Inc., New York.

ROCHE® Pure, crystalline VITAMIN C
(*l*-ascorbic acid, U. S. P.)

VITAMIN DIVISION • **HOFFMANN-LA ROCHE INC.** • NUTLEY 10, N. J.

In Canada: Hoffmann-La Roche Ltd., 1956 Bourdon Street, St. Laurent, P.Q.



CONTROL

Foods can provide many minerals needed for control of body functioning . . . as well as for structure of body tissues . . . but special consideration needs to be given to insure that the diet contains enough of certain minerals.

The minimum quantities of foods listed in *A Guide to Good Eating* can provide most of the Recommended Dietary Allowances for
calcium . . . 2/3 from milk group . . . and 1/4 from other groups.
iron . . . 1/3 from meat group . . . 1/4 from vegetables and fruits . . . and 1/5 from enriched breads and cereals.

Calcium is essential to normal blood clotting, muscle contraction, nerve functioning and cell permeability . . . in addition to its main role in the growth and maintenance of bones and teeth. Iron is used in the formation of hemoglobin, the red blood pigment which carries life-giving oxygen from the lungs to body cells. Phosphorus . . . which plays a vital part in the energy metabolism of cells as well as in formation of bony tissues . . . is provided by foods in all four groups . . . especially those which supply calcium and protein. Potassium, sodium and chlorine are involved with maintaining water balance in the body. Potassium is abundant in animal and plant foods . . . sodium and chlorine are present in foods and table salt. Copper, cobalt, magnesium, manganese, molybdenum and zinc take part in various enzyme reactions . . . and are supplied in needed amounts by foods listed in the "Guide."

A GUIDE TO GOOD EATING — USE DAILY

DAIRY FOODS

3 to 4 glasses milk—children • 4 or more glasses—teenagers • 2 or more glasses—adults • Cheese, ice cream and other milk-made foods can supply part of the milk

MEAT GROUP

2 or more servings • Meats, fish, poultry, eggs, or cheese—with dry beans, peas, nuts as alternates

VEGETABLES AND FRUITS

4 or more servings • Include dark green or yellow vegetables; citrus fruit or tomatoes

BREADS AND CEREALS

4 or more servings • Enriched or whole-grain added milk improves nutritional values

Fluorine . . . not demonstrated to be a dietary essential . . . but shown to give developing teeth substantial protection from dental caries . . . is present in many foods and natural and treated water.

When combined in well-prepared meals, foods selected from each of those four food groups and seasoned with iodized salt can provide all needed minerals . . . while satisfying the tastes, appetites and other nutrient needs of all members of the family . . . young and old.

The nutritional statements made in this advertisement have been reviewed by the Council on Foods and Nutrition of the American Medical Association and found consistent with current authoritative medical opinion.

Since 1915 . . . promoting better health through nutrition research and education.

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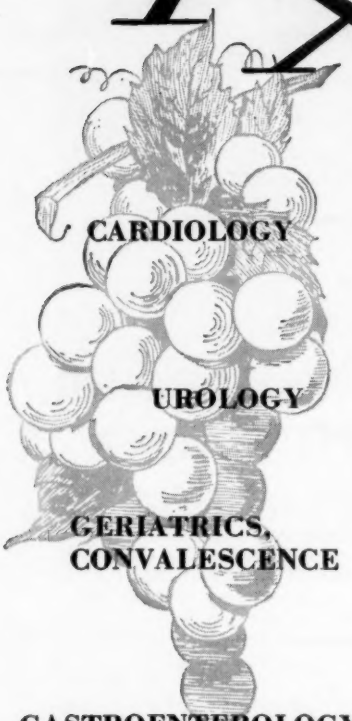
Recent research* confirms the widening Rx FIELD for WINE



CARDIOLOGY

UROLOGY

GERIATRICS, CONVALESCENCE

GASTROENTEROLOGY

DIABETES

WINE has been used with excellent effect for the relief of pain, discomfort, apprehension and anxiety in angina pectoris, thromboangiitis obliterans, Raynaud's disease and hypertension.

The judicious use of WINE can brighten the otherwise monotonous, unappealing diet in renal disease. It increases glomerular blood flow, stimulates diuresis, is nonirritating to the kidneys.

By stimulating appetite, supplying quick energy source, relaxing tensions and increasing morale, the prudent use of WINE has been described as a balm for the convalescent and "milk" for the aged.

In moderate amounts WINE increases gastric secretion, relaxes gastric tension and, therefore, is a valuable aid in the treatment of anorexia, hypochlorhydria, dyspepsia, spastic constipation and diarrhea.

In the normal diet of the diabetic, WINE can serve as an excellent energy source which does not require the participation of insulin.

These and other therapeutic uses for wine are discussed in *"Uses of Wine in Medical Practice." For your free copy write—Wine Advisory Board, 717 Market Street, San Francisco 3, California.

"All my patients get an extra lift with 'Beminal' Forte"

BECAUSE JUST ONE CAPSULE A DAY provides massive doses of vitamin B and therapeutic amounts of vitamin C,* "Beminal" Forte amply meets the need when requirements are high and reserves are low. And when the need is particularly acute, for instance, during long term illness or to accelerate tissue repair, 2 or 3 capsules may be given daily.

Supplied: No. 817 — Bottles of 100 and 1,000 capsules.

FOR PATIENTS ON SPECIAL DIETS, IN INFECTION, OR PRE- AND POST-OP

prescribe

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Therapeutic B Factors with Vitamin C

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*Vitamin C content recently increased to 250 mg. per capsule without increase in cost.

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VITERRA CAPSULES—comprehensive daily supplement. Bottles of 100.

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